THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

[Registered as a Newspaper.]

Vol. XXIX. No. 713.] LONDON, JANUARY 9, 1877. [29th Year.] Price 6d.

RAMSAY'S NEWCASTLE CANNEL COAL. Analysis—12,000 cubic feet of gas per ton of coal; 28-candle gas; coke, 66·70 per cent.; volatile matters, 33·30 per cent. Coke of good quality.

RAMSAY'S PATENT CONDENSED GARESFIELD COKE.

RAMSAY'S ORDINARY GARESFIELD COKE.

RAMSAY'S FIRE-CLAY ARTICLES.

GAS-RETORTS, introduced 1823. FIRE-BRICK WORKS, established 1804. FIRE-CLAY SANITARY PIPES, CHIMNEY-TOPS, and all Goods made of Fire-Clay. The Fire-Clay is worked from Blaydon Main Colliery, is of excellent quality, and no expense spared in perfecting every article. The FIRE-BRICKS (marked "RAMSAY") are to be seen in all parts of the world, and the Works are the most extensive in the Kingdom.

Manufactories—Derwentaugh, Swalwell, and Hebburn Quay, near Newcastle-on-Tyne.

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GENUINE TORBAY PAINT
AND
SPECIAL GASOMETER PAINT.

Four Prize Medals. Established over 20 Years.

These Paints are now used in 150 Country Gas-Works, and by all the London Gas Companies, on Gasholders, Scrubbers, Purifiers, &c. They will cover tar effectually. Also used by the Admiralty, War Office, Railway Companies, Founders, &c.

They prevent and arrest rust, and protect iron from the action of water, sulphurous and gaseous exhalations.

The covering powers are considerably greater than those of any other Paint.—*See "Engineer," Nov.* 2, 1866.

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(Successors to Samuel Calley.)
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BROOKFIELD WORKS,
103, ICKNIELD STREET EAST, BIRMINGHAM,
MANUFACTURER OF
WOOD GRIDS
FOR
SCRUBBERS & PURIFIERS.
CONTRACTOR FOR
LAYING MAINS & ERECTING APPARATUS.
Light Steel Charging Coal and Coke Shovels, Charging Scoops, &c., &c., supplied promptly.

COWEN'S PATENT FIRE-CLAY RETORTS.
JOSEPH COWEN and CO.,
BLAYDON BURN, BLAYDON-ON-TYNE.

Were the only parties to whom a Prize Medal was awarded at the Great Exhibition of 1851, for "Gas-Retorts and other Objects in Fire-Clay," and they were also awarded at the International Exhibition of 1862, the Prize Medal for "Gas-Retorts, Fire-Bricks, &c., for Excellence of Quality."

J. C. and Co. have been for many years the most extensive Manufacturers of Fire-Clay Retorts and Fire-Bricks in the Kingdom. Orders for Fire-Clay Retorts of all shapes and dimensions, and to fit any shaped Mouthpiece, Fire-Bricks, and every other article in Fire-Clay, are promptly executed at their Works as above.

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LIMITED,
THE WEDNESBURY TUBE-WORKS, WEDNESBURY;
AND
THE ALMA WORKS, WALSALL.
Established at the commencement of Gas Lighting.
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16, SOHO SQUARE,
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J. R. & Co., Ld., are the original manufacturers of Wrought-Iron Gas Tubes and Fittings, and Inventors of the LAP-WELDED TUBES for Locomotive and Marine Boilers.

J. R. & Co., Ld., make all kinds of Tubes and Fittings for Gas, Steam, and Water; Gun-Metal Cocks, Stocks, and Dies; Galvanized Tubes and High-Pressure Tubes, &c.

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OF
FIRST-CLASS MATERIALS & WORKMANSHIP;
Also, STATION-METERS, PRESSURE-GAUGES, STREET-LAMPS, REGULATORS, &c.

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CAST & WROUGHT IRON TANKS FOR DITTO,
And Gas Apparatus of every Description.
Marine, Tubular, Cornish, Plain, Furnace, Saddle, and Range Boilers.
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Roofs, Girders, and Bridges, and General Smith's Work.
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ESTIMATES FREE
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RETORT-SETTING A SPECIALITÉ.

ROBUS'S IMPROVED RETORT-SETTINGS guaranteed to carbonize a large amount of coal with a small per cent. of fuel.

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DUKE OF HAMILTON'S
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AGENT:
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NATIONAL STANDARD GASOMETERS

FOR THE ENGLISH GOVERNMENT
AND FOR THE GOVERNMENT OF THE NETHERLANDS
AND OF THE DUPLICATE COPY
Presented by Her Majesty's Government to the French Government,
AND MANUFACTURERS OF

IMPROVED DRY GAS-METERS

Warranted to Measure correctly & not to vary.

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SILVER MEDAL, PARIS EXHIBITION, 1867.

LLOYD AND LLOYD,

ALBION TUBE-WORKS, BIRMINGHAM,

MANUFACTURERS OF

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AND

LAP-WELDED IRON AND HOMOGENEOUS METAL BOILER TUBES.

Boiler-Tube Ferrules, Gun-Metal Gland Cocks, Water-Gauges, Whistles, &c.; Stocks, Taps, and Dies for Screwing, and Gas-Fitters Tools.

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MANUFACTURER OF

EVERY DESCRIPTION OF TUBING, GAS, STEAM, HYDRAULIC TUBES AND FITTINGS,
EITHER BLACK, GALVANIZED, OR ENAMELLED HOT WATER TUBES AND FITTINGS,
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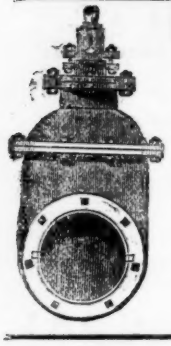
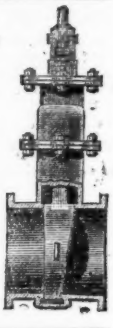
CHANDELIERS, &c., GAS-FITTERS' TOOLS, GAS TONGS, STOCKS, TAPS, DIES, &c., &c.,
HANDRAIL TUBINGS, IRON AND BRASS, PLAIN OR TWISTED,
TELEGRAPH TUBES OR POLES, &c., &c.



C. & W. WALKERS' DOUBLE-FACED GAS-VALVES.



These solidly constructed double-faced Gas-Valves have taken the place of the old system of the light, single-faced disc, which is too uncertain and unreliable in large bores.

They are guaranteed absolutely gas-tight. They are very massive and rigid, and by improved modes of manufacture they are produced at very little excess in cost over the old light, weak system, which is liable to spring and bend, and become leaky.

The Valve is a rigid wedge of solid cast iron, having two perfectly scraped surfaced facings fitting between the two on the body, which are also surfaced.

A spring in two short halves, and, therefore, not liable to break, is used only for scraping the front facing clean.

The front facing is vertical; the back facing forms the wedge.

At a slight additional expense both flanges are faced to bolt to main-pipes.

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FALCON METER-WORKS, OLDHAM,

MANUFACTURERS OF

WET & DRY GAS-METERS, GOVERNORS, PRESSURE & EXHAUST REGISTERS,

&c., &c.

STREET-LAMP METERS in CAST-IRON CASES.

LAMP COCKS AND BRASS FINISHING IN ALL ITS BRANCHES.

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THE MEDAL FOR 1862.

The only Prize Medal awarded for TUBES & FITTINGS.

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ONLY MAKERS OF HOMOGENEOUS METAL TUBES.

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TUBES and FITTINGS for GAS, STEAM, and WATER;
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HYDRAULIC TUBES, BEDSTEAD TUBES, WELL TUBES, TELEGRAPH POSTS, COILS, &c.;
GAS-FITTERS TOOLS, VALVES, COCKS, &c.

THOMAS PIGGOTT & CO.,

(Established 1822,)

SPRING HILL, BIRMINGHAM.

MANUFACTURERS OF

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CAST & WROUGHT IRON TANKS FOR DITTO;

PURIFIERS, CONDENSERS, SCRUBBERS, RETORTS, VALVES;

IMPROVED WROUGHT-IRON RETORT-LIDS, CROSS-BARS, & SCREWS;

AND GAS APPARATUS OF EVERY DESCRIPTION.

SOLE MANUFACTURERS OF LIVESEY'S PATENT GASHOLDER MAN-LID,

By use of which Man-lid, inlet and outlet pipes can be examined and cleansed without loss of gas in crown of holder, or ingress of atmospheric air.

ROOFS, GIRDERS, BRIDGES, AND BOILERS OF ALL KINDS.

Drawings, Specifications, and Estimates supplied on application.

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(Successors to JOHN WILLIAM O'NEILL & CO.,)

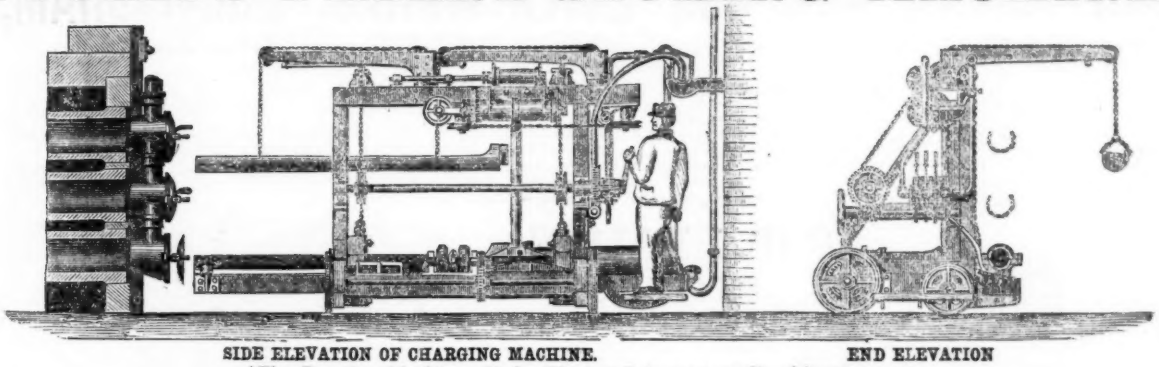
Offices—PALMERSTON BUILDINGS, OLD BROAD STREET, LONDON, E.C.,

CONTRACTORS FOR GAS PURIFICATION BY OXIDE OF IRON.

The superiority of the material supplied by this Company is generally recognized, and it is now in use in nearly all the London and most of the large Provincial Gas-Works.

JOHN WILLIAM O'NEILL, SAMUEL H. JOHNSON, } Joint Managing Directors.

FOULIS'S PATENT STOKING MACHINE.



SIDE ELEVATION OF CHARGING MACHINE. END ELEVATION

(The Drawing Machine will be Illustrated in next week's Advertisement.)

Makers: TANGYE BROTHERS and HOLMAN, London and Birmingham; ADAM WOODWARD and SON, Manchester; ROBERT LAIDLAW and SON, Glasgow; MASCHINENBAU-ACTIEN-GESELLSCHAFT HUMBOLDT, Kalk bei Deutz; Or all particulars may be had from JAMES WOTHERSPOON, 31, St. Vincent Place, Glasgow.

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WORTLEY FIRE-BRICK WORKS,

NEAR LEEDS,

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SPECIAL NOTICE.—Our Patent Machine-made Retorts have now been in *actual work* nearly 800 days, and are yet in good order. References on application.

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LIMITED,

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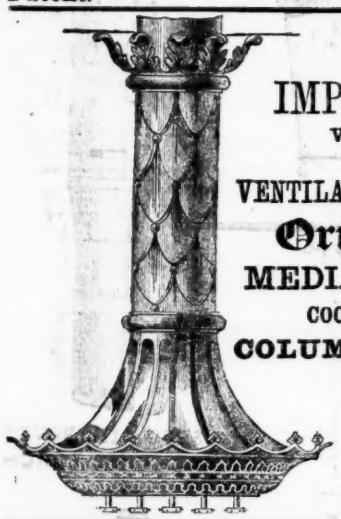
MANUFACTURERS OF

"WET" & "DRY" GAS-METERS IN IRON & TIN-PLATE CASES,

STATION-METERS AND GOVERNORS, STREET-LAMP METERS, BOXES, AND REGULATORS FOR THE AVERAGE METER SYSTEM.

Attention is called to their Dry Meters in Wood Cases, as used by the principal London Gas Companies. These Meters are especially suitable for seaport towns and for export.

The Company repair or convert every description of Wet Gas-Meters to De Castro and Burton's Patent.



HODGE & CO.'S

IMPROVED VENTILATING SUN-LIGHTS

WITH TALC REFLECTORS AND SELF-ACTING VALVES TO PREVENT DOWN-DRAUGHT;

VENTILATING GLOBE LIGHTS for DINING-ROOMS, LIBRARIES, &c.

Ormolu, Bronze, & Crystal Gaseliers;

MEDIÆVAL CHURCH WORK AND CORONÆ

COCKS, VALVES, and FITTINGS for GAS, STEAM, and WATER;

COLUMNS, BRACKETS, & STREET LANTERNS;

BLACK AND GALVANIZED BARREL COMPO AND TIN PIPE.

GAS ENGINEERS,

100, HATTON GARDEN, LONDON.

Drawings and Prices upon application.

JOHN WRIGHT AND CO., ESSEX WORKS, BIRMINGHAM,

Beg to call the attention of MANAGERS and DIRECTORS of GAS COMPANIES to the following letter which they have lately received.

COPY OF LETTER RECEIVED FROM MAGNUS OHREN, Esq.

Crystal Palace District Gas Company, Lower Sydenham, S.E.

To Messrs. John Wright and Co., Essex Works, Birmingham.

Dear Sirs,—In reply to your inquiries, I am glad to state that the use of GAS COOKING AND HEATING STOVES has been a complete success here. We have several hundred in use in our districts. We also find it advantageous to let out Stoves at a small rental. We have now 275 Stoves at rent.

The Stoves you make I can with confidence recommend, having so many in use, and giving satisfaction. I need scarcely point out to you the advantage to Gas Companies to recommend the use of Gas Stoves to their Gas Consumers, even where they do not supply them on sale or rent, as the use of Gas Stoves brings day consumption, and thus the Company make a profit by day as well as by night.—I am, dear sirs, yours faithfully, MAGNUS OHREN.

Size, 25½ in. high; 14 in. wide; 12½ in. back to front.

Price 50s., complete with Pan and Gridiron.

GAS HEATING STOVES

(TERRA COTTA AND IRON).

THE CHEERFUL STOVE.

COOKING STOVES.

BREAKFAST COOKERS.

BATHS HEATED by GAS

GAS STOVES

For Boiling, Broiling, Preserving, Heating Flat Irons, and for all other Domestic Purposes.

Gas Companies and the Trade who have not our Illustrated Catalogue are respectfully requested to apply for same.

A LIBERAL DISCOUNT to the TRADE.

No. 4003.

THE CHEERFUL GAS STOVE, with Copper Reflector,

Has all the appearance of a Bright Fire.

PRICE from 32s.

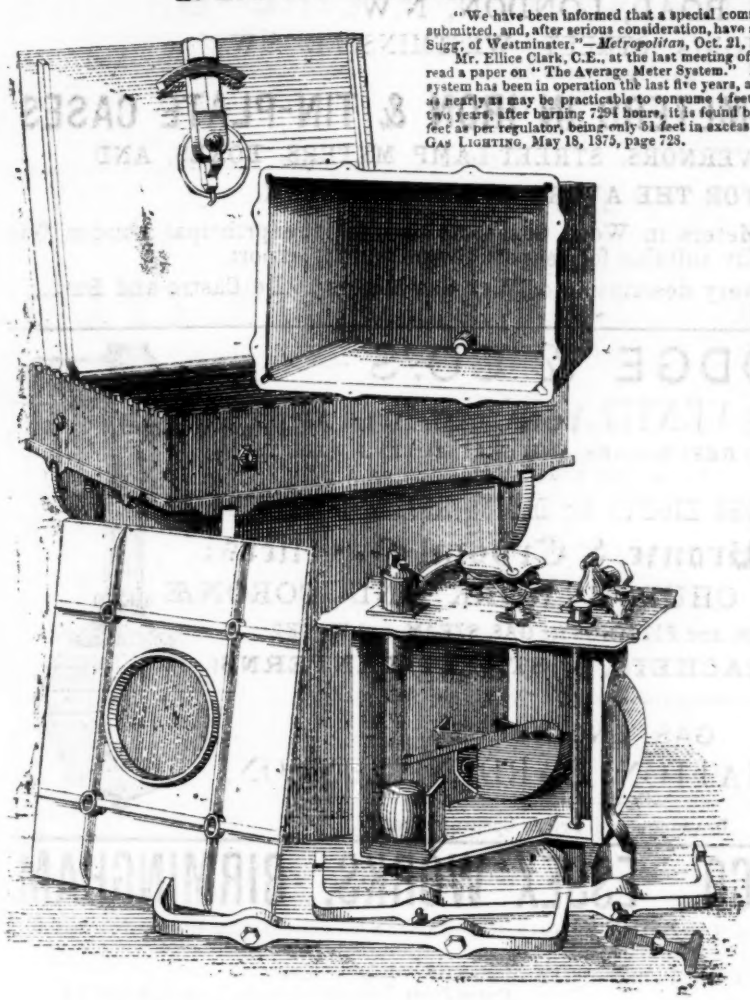
PUBLIC LIGHTING ON THE AVERAGE METER SYSTEM.

PATENT PUBLIC LAMP METERS,

AS NOW ADOPTED BY THE PARISH OF ST. MARY ABBOTTS, KENSINGTON.

"We have been informed that a special committee made a most exhaustive examination of the sample meters submitted, and, after serious consideration, have selected the new Patent Public Lamp Meter, invented by Mr. William Sugg, of Westminster."—*Metropolitan*, Oct. 21, 1876.

Mr. Ellice Clark, C.E., at the last meeting of the Association of Municipal and Sanitary Engineers and Surveyors, read a paper on "The Average Meter System." Referring to Folkestone, he said that "The Average Meter Indicator system has been in operation the last five years, and found to act well. Sugg's Self-Acting Regulator is used, adjusted as nearly as may be practicable to consume 4 feet per hour, and so very satisfactory is this apparatus that, for the last two years, after burning 7294 hours, it is found by the Average Meter to have consumed 29,227 feet, as against 29,176 feet as per regulator, being only 51 feet in excess of that which the apparatus is adjusted to consume."—JOURNAL OF GAS LIGHTING, May 18, 1875, page 728.



SUGG'S IMPROVED
LIGHTING TORCH.

SMALL SIZE
LAMP GOVERNOR
For the inside of Lantern, with double regulation.

WILLIAM SUGG'S
IMPROVED PATENT LAMP METER,

With adjustable Lid to suit the Slope of any Pavement.

Can be easily cleaned and repaired by any ordinary workman. Improved index and patent flexible joints. The inlet service and the connexion to stand-pipe can be cleaned out without opening the ground the lid covers both of these. Clear glass plate on internal lid.

SUGG'S IMPROVED
LAMP COLUMN & LANTERN,

AND THE METHOD OF FIXING THE AVERAGE METER.

NOTE.—This kind of Meter was originally invented by William Sugg, in conjunction with Mr. Thomas Hawksley, Past-President of the Institute of Civil Engineers. They were first used at Nottingham in 1866, and are still at work. The Gaslight Company and the Corporation were both quite satisfied with the results. They were also introduced at Folkestone in 1869 by the late Mr. T. G. Barlow, Editor of the JOURNAL OF GAS LIGHTING. The success of the system put an end to a very long and troublesome dispute between the gas company and the local authorities. They are still at work with the same satisfactory results. They have since been used in several important towns, with equally good results.

No other kind of Lamp Meter has ever achieved so complete a success.

WILLIAM SUGG'S
PATENT PUBLIC LAMP GOVERNOR,

With Steatite Incorrodible Burners.

Guaranteed to give the greatest amount of light for the quantity of gas consumed. Nearly a Million of these, and those of William Sugg's later inventions, are in use in various parts of the globe.

MODERN STREET LIGHTING.

BY WILLIAM SUGG, A.I.C.E.

Price 1s. 6d.

LIGHTING TABLE.

Diagram showing the Curves of Sunset and Sunrise throughout the Year.

Price 2s. 6d., Litho.

WILLIAM SUGG, GAS ENGINEER,

VINCENT WORKS, VINCENT STREET, WESTMINSTER.

THE FARNLEY IRON COMPANY, LIMITED,

FARNLEY, near LEEDS,

MANUFACTURERS OF

FIRE-CLAY GAS-RETORTS & FIRE-BRICKS,

Of every size and shape, and of the best quality; also of White and Coloured GLAZED BRICKS, SANITARY PIPES, &c., &c.

In order to meet the constantly increasing demand for their Gas-Retorts, the F. I. Co. have recently made such an addition to their premises as will enable them to execute expeditiously the largest home or foreign orders.

London Agent for Gas-Retorts: D. W. OGG, 3, Jeffrey's Square, St. Mary's Axe, E.C.

" " Glazed Bricks: A. BARFIELD, 22, Great George Street, Westminster.

LIVESEY FIRE-CLAY WORKS.

NEAR BLACKBURN, LANCASHIRE.

(ESTABLISHED 1835.)

ORLANDO BROTHERS, LIMITED,

MANUFACTURERS OF PATENT CLAY RETORTS,

AND EVERY DESCRIPTION OF

TUBULAR GLAZED SEWERAGE PIPES, BENDS, JUNCTIONS, ETC.

FIRE-BRICKS, TILES, BLOCKS, AND CHIMNEY-TOPS

SIZE STRENGTHS OF ROLLED JOISTS.

A	B	C	D	E	A	B	C	D	E
41	19¾	7"	102	810	19	6"	5"	30	85
1	16"	6½	57½	400	17	6¼	3"	18	45
31	15"	5"	50½	330	18	6¼	2"	10¾	30
9	14"	5½	60	325	20	5½	2"	10&12	22½
4	12"	6"	56	300	35	5½	7¾	16½	50
5	12"	5½	42	220	23	5"	4½	23	55
30	10"	5"	66	175/3	22	5"	3"	13	30
8	10"	4½	32	130	36	4¾	2"	8	17½
32	9½	4½	23	116	40	4"	3"	11	20
9	9¼	3½	24&30	90	25	4"	2"	8½	14
33	6¾	2¾	18	60	37	3"	2"	5½	10
12	6"	4"	22	80	38	3"	3"	9	17½
11	6"	5"	29	95	A	No on Section Sheet			
13	6"	2½	15	40	B	Depth in Inches			
39	7"	4"	22½	70	C	Width of Flange			
15	7"	3½	19	60	D	Usual Weight Per Ft			
16	7"	2¼	14	35	E	Constant.			

TO FIND SAFE DISTRIBUTED LOAD IN TONS DIVIDE THE CONSTANT BY THE SPAN IN FEET.

ROLLED JOISTS & FLITCHES KEPT IN STOCK

CHAS WILLIAMS, & Co.,

ENGINEERS AND IRON FOUNDERS.

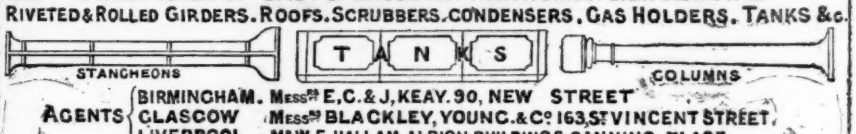
90 CANNON STREET LONDON. E.C.

RIVETED GIRDERS

FLITCHED BEAM

MANUFACTURERS OF CAST & WROUGHT IRONWORK OF EVERY DESCRIPTION

RIVETED & ROLLED GIRDERS. ROOFS. SCRUBBERS. CONDENSERS. GAS HOLDERS. TANKS &c.



AGENTS { BIRMINGHAM. Messrs E,C. & J, KEAY. 90, NEW STREET
GLASGOW Messrs BLACKLEY, YOUNG. & Co 163, ST VINCENT STREET.
LIVERPOOL M & W, E, HALLAM, ALBION BUILDINGS, CANNING PLACE }

SECTION SHEET, AND PARTICULARS ON APPLICATION TO THE ABOVE.

JOHN ABBOT AND CO.,

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IRON AND BRASS FOUNDERS,

PARK WORKS, GATESHEAD-ON-TYNE.

London Office: 2, SUFFOLK LANE, CANNON STREET.

Glasgow Office: 54, ST. ENOCH'S SQUARE.

MANUFACTURERS OF ALL DESCRIPTIONS OF

HYDRAULIC MACHINERY,

INCLUDING

ACCUMULATORS, FORCE-PUMPS, CRANES, & LIFTS,

FOR

GAS-WORKS, WAREHOUSES, &c.

IMPROVED HYDRAULIC MACHINERY,

Specially Arranged for Lifting and Lowering Purifier-Covers, &c.

MAKERS OF

PURIFIERS, CONDENSERS, SCRUBBERS, RETORTS;

PIPES FOR GAS AND WATER WORKS;

ROOFS, COLUMNS, AND GIRDERS.

DESIGNS AND ESTIMATES SUPPLIED ON APPLICATION.

HUNT'S PATENT EQUILIBRIUM GAS-GOVERNOR.

In this Governor a Throttle-Valve is substituted for the ordinary suspended Cone, all external communications being avoided by placing the Lever or Radius Arm (shown in the drawing) inside the Valve-Chamber upon the Disc. The Disc is carried upon steel centres, upon which it is accurately balanced and turns freely. The friction in working is thereby reduced to a minimum. This Governor is extremely sensitive to alterations of inlet or outlet pressure, and renders a large actuating holder unnecessary.

The principal advantages of this arrangement over the ordinary form of Governor are as follows:—

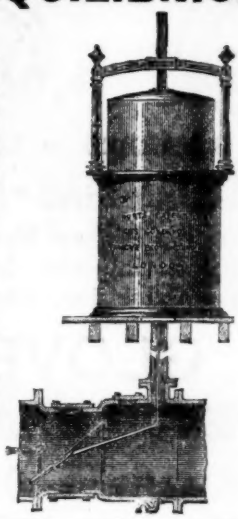
Its sensitive action prevents oscillation.

It is self-adjusting—*i.e.*, it maintains a steady pressure under variations of inlet pressure or a fluctuating consumption.

The inlet to Gasholder being contracted to the smallest possible dimensions, all danger from leakage through insufficiency of seal, tilting, &c., is entirely avoided.

The valve portion being separate from the holder, it can be handled and fixed like an ordinary Slide-Valve direct in the main; and the holder can be placed at any convenient distance immediately above it. The cost is thus materially reduced, and the inconvenience of heavy lifts done away with.

There are no working parts likely to get out of order.



These Governors have been adopted by many leading Companies, among whom are the following:—

The Gaslight and Coke Co. (9), The London Gas Co. (3), and at Abergavenny, Birmingham, Cannes (France), Devonport, Dursley, Exeter, Mentone (France), Monmouth, Newcastle-on-Tyne, Oxford, Plymouth, Rochdale, &c.

TESTIMONIAL.

The Gaslight and Coke Company,
9, Water Street, New Bridge Street,
Blackfriars, E.C., Feb. 27, 1875.

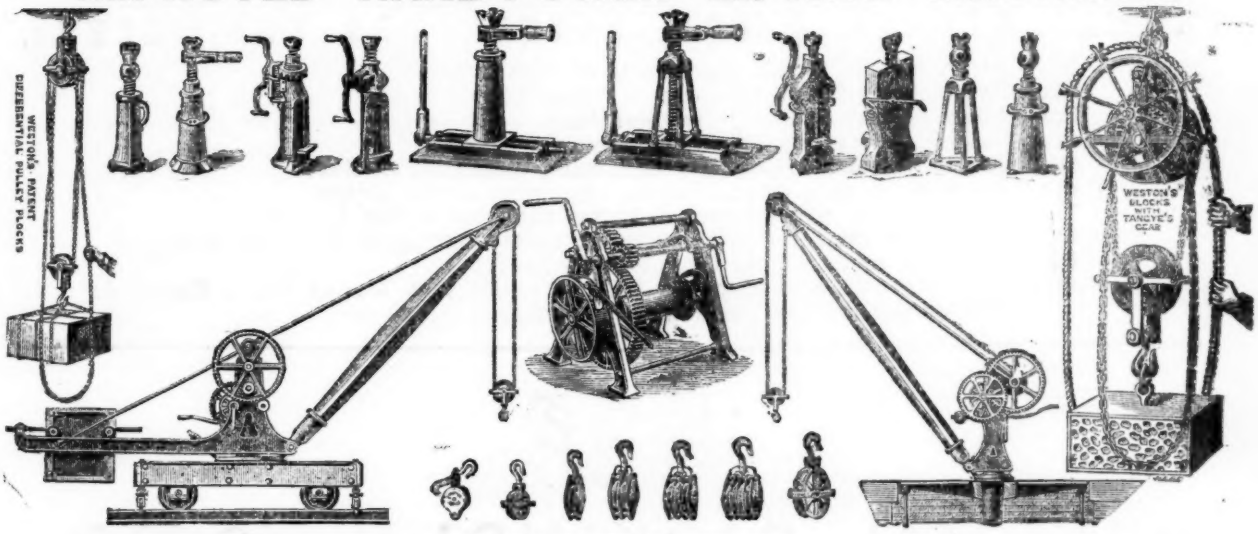
MESSRS. TANGYE BROTHERS AND HOLMAN.

Gentlemen,—The two 24-inch and three 36-inch Hunt's Equilibrium Governors supplied by you, and fixed in the valve-rooms at Whitechapel, Goswell Road, and Blackfriars, are working very satisfactorily.

Yours truly,

(Signed) JOHN JOHNSON.

IMPROVED HAND-POWER LIFTING MACHINES.



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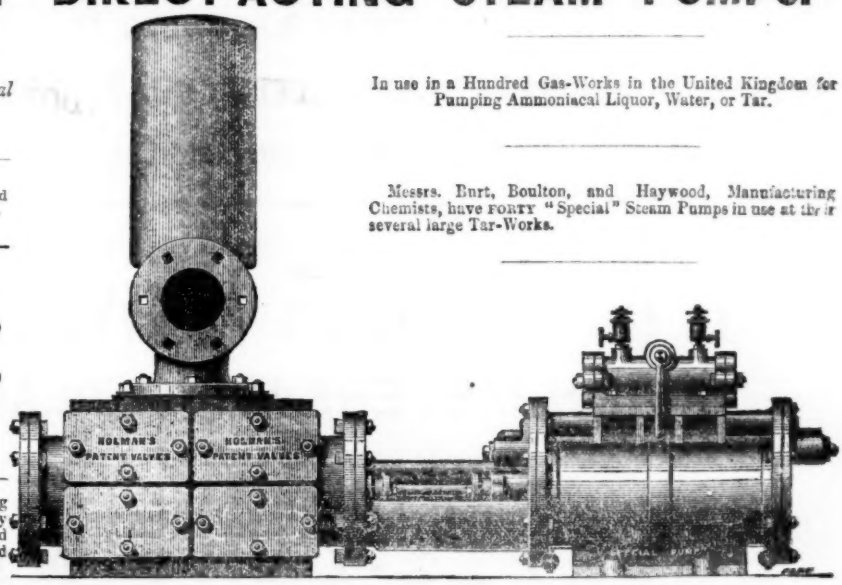
The following are a few of the leading Sizes in use in Gas-Works and Chemical Works:—

Diameter of Steam Cylinder.	Diameter of Water Cylinder.	Length of Stroke.	Gallons of Water per Hour, Approximate.	Reduced Prices.
3	1½	9	450	£16
4*	2	9	815	18
3	3	9	1,830	18
5	2½	12	1,250	21
5*	3	12	1,830	22 10
4	4	12	3,250	25
6*	4	12	3,250	30
5	5	12	5,070	32 10
7*	5	12	5,070	40
6	6	12	7,330	40
8*	6	12	7,330	50
7	7	12	9,750	50
10*	7	12	9,750	65

* These sizes being usually selected for pumping Tar and Liquor, are always in stock, or nearly ready, fitted with all pump details in iron, and extra length distance piece between steam and pump cylinder at a small extra cost.



In use in a Hundred Gas-Works in the United Kingdom for Pumping Ammoniacal Liquor, Water, or Tar.

Messrs. Burt, Boulton, and Haywood, Manufacturing Chemists, have FORTY "Special" Steam Pumps in use at their several large Tar-Works.

TANGYE BROTHERS AND HOLMAN,

LAURENCE POUNTNEY LANE, LONDON, E.C.

London 1851. New York, 1853 Paris, 1855. London, 1862.

Dublin, 1865

The SIX MEDALS AWARDED to THOMAS GLOVER for

PATENT DRY GAS-METERS,

The latter being the Highest Medal awarded for Dry Gas-Meters by the Imperial Commissioners for the Universal Exhibition, Paris, 1867.

Paris, 1867.

THOMAS GLOVER & CO.,

DRY GAS-METER MANUFACTURERS,

214 TO 222, ST. JOHN STREET, CLERKENWELL GREEN,

LONDON, E.C.

THOMAS GLOVER & CO.'S PATENT DRY GAS-METERS,

1st, Are a remedy for all the defects of Wet Meters;
2nd, Are suitable for all climates, whether hot or cold;
3rd, Incur no loss of Gas by evaporation;
4th, Cannot become fixed by frost, however severe;
5th, Are the most accurate and unvarying measurers of Gas;
6th, Prevent jumping or unexpected extinction of the Lights;
7th, May be fixed either above or below the level of the Lights;
8th, Cannot be tampered with, without visibly damaging the outer case;
9th, Will last much longer than Wet Meters;
10th, Will not cost more than one-half for repair that Wet or Water Meters do;
Are upheld for five years without charge.

WILLIAM PARKINSON & CO.,

(SUCCESSORS TO SAMUEL CROSLEY,)

COTTAGE LANE, CITY ROAD, LONDON, E.C.

Established 1816.

MANUFACTURERS OF PATENT

WET & DRY GAS-METERS,

STATION-METERS WITH PLANED JOINTS,

GOVERNORS, PRESSURE REGISTERS, GAUGES,

AND EXPERIMENTAL APPARATUS,

STREET-LAMP METERS,

AND REGULATORS FOR AVERAGE METER INDICATION.

METERS FOR MEASURING WATER.

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NOTICE TO SUBSCRIBERS.

The JOURNAL OF GAS LIGHTING is supplied direct from the Office to residents in any part of the United Kingdom, at the rate of 21s. per annum, payable in advance. If credit be taken, the charge is 25s.

Subscribers who desire to avail themselves of the reduction in the subscription to the JOURNAL by paying in advance for the year 1877, are reminded that this can only be done during January.

Vol. XXVIII. (second half of 1876) will shortly be ready, bound in cloth, gilt letters, price 18s. Cloth cases for binding may now be obtained on order from any bookseller, or from the Publisher.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion, must be authenticated by the name and address of the writer; not necessarily for publication, but as a guarantee of good faith.

Mr. GOOD (Carshalton) *writes: "As the correspondence on the Removable Dip-Pipes is closed, I purpose to bring the subject before the Gas Managers Association at their next meeting."*

A GAS MANAGER OF THIRTY YEARS EXPERIENCE *writes: "The explosion of the gas-meter described by 'S. E.' in the last* JOURNAL *seems capable of explanation by supposing that the gas within it must have been mixed with air containing oxygen sufficient to render the mixture explosive. A foolish and dangerous practice is sometimes resorted to, to remove water condensed in the fittings by blowing it backwards and into the meter along with air enough to make it explosive, and an application of light to a jet near to the meter might have the effect described. If, however, one jet was being supplied, and burning steadily from the meter for some time previously—of which there may be some doubt—the explanation offered must fail; and it does seem, from the description of the accident, that the explosion was within, not outside of, the meter."*

THE JOURNAL OF GAS LIGHTING,
WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, JANUARY 9, 1877.

Circular to Gas Companies.

IF the allegation be true, that Gas Companies are in the habit of taking every opportunity for the expenditure of capital, in order that they may extort as much as possible from the pockets of their customers, it must, we fear, be admitted, that many, or most, Corporations possessing gas-works, "starve" their undertakings as regards capital expenditure, and thus prevent the realization of all the advantages that might be derived from their possession. The reason for this is not far to seek. The free-born Briton naturally hates "taxes"; but the intense hatred he entertains for "rates" can only be understood by one who pays them. For the former, he sees a visible result, for the most part embodied in an Army and Navy, of which we need say nothing. For the latter he is often puzzled to see what he gets. Hence, to cut short a story which might be made very long, the ordinary borough ratepayer has a horror of loans, of which he naturally expects that he will be compelled, in part, to pay the interest. Unfortunately, he does not discriminate between loans for works which will be remunerative, and those for works which must necessarily be unprofitable in a directly pecuniary sense. Thus it happens that local councils are not unfrequently deterred, by the fear of popular opposition, from contracting debts to extend such remunerative undertakings as gas-works, which might, in the end, produce great advantages to ratepayers, or, as we prefer to put it, to ratepaying gas consumers.

We always allude with delicacy to the case of Manchester, which is altogether *unique;* but even in this model city, as regards the gas undertaking, it would seem that the Town Council have postponed, to the very latest moment, the construction of additional works, which are, or will be within a year or two, absolutely necessary to keep up an adequate supply of gas. There was no necessity for this delay at Manchester; for any additional works required might have been constructed out of the gas profits, without a fresh debt being incurred by the Corporation.

But if we cross the river to Salford, a somewhat different condition of affairs obtains. The gas-works belonging to the Corporation of Salford, it is clear, are by no means in a satisfactory state, and are quite inadequate to maintain a proper supply of gas at the present time. Perhaps the carbonizing department is not altogether insufficient; but it would seem that the purifying apparatus in existence is capable of only half purifying the amount of gas made. From this cause it seems that many complaints of the quality of the gas arise, and it must be clear to every one that such serious deficiencies should be immediately remedied. With some rearrangement of the existing works, these additions, it is estimated, will cost the Corporation £30,000. But then comes the question of extensions for future requirements, which, it is calculated, will cost £130,000. At the prospect of this expenditure, the Town Council evidently take fright, although their Gas Committee propose that it shall be extended over seven years, additions being made as they are rendered necessary. There are evidently people in Salford who cannot see that this annual expenditure of some £20,000 is certain to prove remunerative to the Corporation in consequence of the increase in the consumption of gas every year. They only look at the capital amount, and fear that this must prove an additional burden. This sort of popular ignorance is what a Town Council have often to contend against. The further consideration of the Gas Committee's report has been deferred for a time; but the ultimate conclusion will inevitably be, that the work recommended must be done. The Gas Committee *may*, in the past year or two, precipitately, badly-advised, or ill-informed, have made extravagant coal contracts; but on these matters of alterations and extensions of works, they seem to us to be perfectly in the right, and we may be certain that in the end they will receive the full support of the Council.

At Rochdale, a not very dissimilar state of affairs is revealed. There, too, the gas undertaking of the Corporation has been somewhat "starved" by the parsimony of the Council. It would appear that the existing works are barely adequate for present requirements. The statement is made, and does not seem to be contradicted, that one dark day last year the district was within a few minutes of complete darkness, from a want of producing power. This was on an altogether exceptional day; but such emergencies must always be provided for. The Gas Committee now propose to expend £150,000 on the purchase of land and

the erection of new works, and, as a matter of course, there is a great outcry against the scheme. The "hand-to-mouth" system is advocated, as usual. Lengthen the retort-house, and add bench after bench as they may be required; make a single-lift into a double-lift gasholder, and everything that will be necessary for the next five years will be accomplished. We venture to think that this sort of tinkering never answers. In the long run, it is much more economical to build new than to patch old works. This the Rochdale Corporation will, in time, discover. There is one argument used by the opponents of the outlay recommended by the Gas Committee, which deserves consideration. The increase in the consumption of gas in the district of the Corporation is not so large as it used to be in past times. The Corporation have made praiseworthy efforts to secure the consumption of gas, even in the smallest cottages, and they have succeeded. For any increase they have therefore to rely upon the natural development of the population, or upon immigration to the district. From the latter source, with the present condition of things, we rather think no great increase is to be expected, and, therefore, the Corporation may be wise in hesitating before they commit themselves to a large addition to the burdens of the town.

If there are towns—we here avoid the use of the word Corporations—without enterprise, and some without prospects, there are others in which neither enterprise nor prospects are lacking. One of these is Nottingham. Two years ago this town acquired one of the most substantial and promising gas undertakings in the kingdom. During the existence of the company, the annual average rate of increase in consumption amounted to about ten per cent., and it would seem that, since the undertaking came into the hands of the Corporation, the rate of increase has been somewhat higher. Further than this, the Corporation limits exceed those which the Company possessed, and some portions are altogether unsupplied. The existing works—three in number—in their present stage of development, are only equal to the production of 4,700,000 feet of gas per diem, and on the 24th of December, 1875, the quantity of gas delivered or consumed amounted to 4,139,000 cubic feet. Under these circumstances, the engineer of the Corporation, Mr. Tarbotton, has pressed on the Council the necessity for making immediate extensions. It is only fair to the defunct company to say that they had contemplated making large extensions, and had, we believe, acquired the additional land at Basford, which Mr. Tarbotton now proposes to utilize. The last works constructed by the Company at Basford, are some of the handsomest and most substantial in the kingdom, and we may be forgiven for expressing a hope that the general design of the new works will harmonize with that of those already in existence. Æsthetics are but little studied in connexion with gas-works; but even in these there is scope for some artistic display.

We need not allude in detail to the extensions recommended. They consist mainly in quadrupling the capacity of the Basford works. But it would seem certain that at no distant time, if a revival of trade take place, the rich mineral district to the north-west of Nottingham will receive a large accession of population, who will require to be supplied with gas. The ground is irregular and perplexing, but Mr. Tarbotton has selected two sites for new works, either one of which appears to be well adapted for the purpose. At the present moment we are not aware that either site proposed has been adopted by the Town Council of Nottingham. No estimate of the cost of the alterations and extensions is given in the report we notice, but that does not matter. The Engineer enjoys the fullest confidence of the Council, and the latter, we believe, have the confidence of their constituents, so that whatever is proposed will, we have no doubt, be carried out, and to a successful issue. The ratepayer, we do not think, will obtrude in this case.

The gas accounts of the Corporation of Carlisle show that in the course of the year ending June 30, 1876, a gross profit of £5401 has been made by working the undertaking. Out of this sum £2228 has been expended on extensions; and, after paying £200 to the Corporation, setting apart £150 for interest on deposits, and paying off mortgages to the amount of £989, there remains a balance of £1833 to be carried forward. We may again object to the form in which the accounts are presented, and once more express a hope that all Corporations will make out their statements in the form prescribed for gas companies by the Gas-Works Clauses Act, 1871. If this be done, we shall always be able to follow the details, and form a judgment as to the results.

Monday, the 22nd inst., has been fixed by the Mayor of Warrington as the day on which voting papers will be distributed to ascertain the opinion of the majority of the ratepayers on the gas purchase question. We shall be glad when the matter is settled one way or the other, for the flood of ink now being expended on the discussion compels us to much reading, which is not always pleasant, and is never profitable. The leaders of the opposition have displayed so much ignorance, and have been so unscrupulous in making statements which could not be supported, that we are not surprised to hear a considerable change of opinion has taken place in the borough, and that, after all, the Council are likely to be supported by the ratepayers. If we did not believe the directors of the Gas Company to be honourable gentlemen, we might suppose the opposition to be stimulated by them. They have no desire to part with their property, but having agreed to sell, we have no doubt they have loyally abstained from taking any part in the recent discussions.

At the last meeting of the Warrington Council, the question was brought forward, how far the purchase was likely to prove beneficial to gas consumers, as distinct from ratepayers. There is no doubt that a Corporation gas undertaking may be made use of as an instrument of extortion. When a town hall is built out of gas profits, it is clear that gas consumers alone have been taxed for its construction. Now, what might be quite fair in Rochdale, where, as said above, the consumption of gas is almost universal, might be grossly unjust in another borough in which the consumption of gas was less general. Councillor Platt sees this clearly enough, and is, no doubt, perfectly right in his opinion, that no reduction of price is likely to result from a change in the proprietorship of the gas undertaking. The chances of a reduction of price lie rather with the retention of the undertaking by the Company.

If the Warrington people wish to know what a Gas Company can do, they have not to go far to learn. Preston is close by, and the circumstances of the two places are, we think, not very dissimilar. At Preston nineteen or twenty candle gas has hitherto been supplied by the Company, at 4s. 2d. per 1000 feet, with a discount of fifteen per cent. to the smallest, and twenty per cent. to large consumers. The Company have now resolved to reduce the price to 3s. 9d. per 1000 feet, allowing the same discounts, which makes the cost 3s. 6½d. to small and 3s. 4d. to large consumers. The Town Council of Preston wisely consider that they are not likely to do better than this, and show no disposition to acquire the gas undertaking.

With reference to the arrival of a cargo of "Hartley Mineral" from New South Wales, which we announced last week, we have received information that there is practically no limit to the supply, if a satisfactory price can be arranged. The recent importation, we are told, has been sold in the docks for 80s. per ton. With Boghead difficult to obtain in the London market at 75s., there may, considering the alleged superior richness of the "Hartley Mineral," be some advantage in its purchase at the price named.

The report of the Chief Gas Examiner shows that the Metropolitan Gas Companies under his supervision continue to supply gas fully equal to statutory requirements and the Instructions of the Referees. The illuminating power of the gas, it will be seen, has been, with one exception, fully kept up to the parliamentary standard. The Instructions of the Gas Referees, as to the purity of the gas, have been for the most part fairly complied with. Ammonia, of which no Gas Company would lose a grain, if they could possibly retain it, has been kept down to its lowest limits. As regards "sulphur"—the removal of which presents greater difficulties, and the taking out of which is altogether unprofitable, so long as the companies keep themselves within the prescribed limits, and save themselves from forfeitures—it will be seen that the maximum of the Referees has been rarely exceeded. Some sulphuretted hydrogen has been more than once discovered in the course of the past quarter; but whenever the presence of this gas is demonstrated, our word may be taken that it is the result of a simple accident, and arises from unavoidable causes.

Death of Mr. Joseph Braddock, Sen.—Many of our readers will hear with regret of the death of the above-named gentleman. The event occurred at his residence, Fairfield, near Manchester, on New Year's morning, after an illness of but a few minutes duration. In early life Mr. Braddock received his business training at the Oldham Gas-Works, under Mr. Emmott, and left in 1835 to take the management of the Preston Gas-Works, where he remained two years. In 1837 he received the appointment of manager of the York Gas-Works, and retained the position 31 years. It is not too much to say that it was largely due to his thorough knowledge of the profession that the York Gas Company became one of the most successful in the kingdom. On his retirement from that post in 1868, he returned to Oldham, and, with his nephew, constituted the well-known firm of J. and J. Braddock, of the Globe Meter-Works. Mr. Braddock had attained the age of 64 years. He was interred in the family grave at Mottram Church on the 5th inst.

Buenos Ayres Gas Supply.—A Reuter's telegram, received at Southampton on the 1st inst., brings advices from Buenos Ayres to the 1st of December. The *Buenos Ayres Standard* says: "The Provincial Legislature is still in session, and has just passed a new municipal law, by virtue of which the Municipality will be able to pay off its heavy debts to both gas companies."

Water and Sanitary Notes.

THE year opens with an abundance of water, and yet we have no assurance that Midsummer will not find many districts in great want of supply. Much has been written by Mr. Bailey Denton and others on the necessity of storing up the rainfall for the supply of those villages which, from their position, are peculiarly liable to suffer from drought, but nothing has been done. If, as is quite possible, after these excessive rains, we have a very dry summer, a lesson will have been taught, which we hope will not be forgotten in the future.

We were quite right in our surmise, that little more would be heard of the York "filibustering" Water Bill. Mr. Gutch has decided on withdrawing it, which, for one reason, we regret. He and his supporters should have been made to pay handsomely for their audacious attempt. But this would have involved considerable expenses to the existing Water Company, and also the Corporation, and matters are, perhaps, best as they are. There can be no doubt that the water of the Ouse, pumped from the new intake of the York Company, will be one of the most wholesome and palatable waters in the kingdom—infinitely superior, in every sense, to the vapid stuff Mr. Gutch would have collected and distributed, if he could have procured it in sufficient quantity, and procured the necessary powers, which he never would have obtained. We hope soon to receive the report of the "Newcastle" analyst on the quality of the Ouse water, and then we may make some remarks on this case in particular, and the reports of water analysts in general. It will be curious to see placed in juxtaposition the analytical results, and the opinions expressed by different analysts as to the wholesomeness or not of different waters submitted to them for examination. The labour of collation will, however, be large, and the work must be deferred for a time.

Our columns show that an attempt is about to be made by the Corporation of Bristol to purchase the undertaking of the Bristol Water-Works Company. The two parties approach each other in the most amicable spirit, and perhaps we shall not be wrong in conjecturing that, before long, the undertaking will belong to the Corporation. We are rather afraid that Water Companies have, since the precedent established in the Stockton and Middlesbrough case, been disposed to behave, in the face of a Corporation, much in the same way as did the racoon in a tree, who found himself face to face with the renowned American sportsman, Colonel Crockett. "Don't shoot," said meekly the animal, when he saw himself covered by the Colonel's gun; "I'll come down." So Water and Gas Companies seem disposed to "come down" whenever a Corporation offers to take a shot at them. There is really no necessity for this exhibition of meekness. The Bristol Company are perfectly secure, notwithstanding the threats of corporate and other opposition. Nevertheless, they may "come down," and with good grace, and accept such terms as the Corporation Crocketts will be compelled to pay. The Bristol Company are a ten per cent. Company, and the parliamentary terms for the purchase of such an undertaking are now fully settled. No *laches* can be attributed to the Company, and therefore the best terms must be given. The Corporation of Bristol will probably consent to pay the only price that could be accepted, and thus one more important water undertaking may pass into the hands of a Municipality.

An appeal by the Birmingham Corporation against the assessment of their reservoirs, filter-beds, engine-houses, and works, in the parish of Shustoke, came before the Warwickshire Quarter Sessions last week. The gross amount of the rate appealed against was £5350, the net rateable value being taken at £4280. After an inquiry extending over three days, the Court amended the rate by substituting £3593 as the gross, and £2875 as the net rateable value. We reserve a report of the evidence till our next number.

LAMBETH WATER-WORKS COMPANY.—Mr. G. H. Louttit has been appointed secretary of this company, in the room of Mr. W. S. Phipps, who has retired.

INSTITUTION OF CIVIL ENGINEERS.—Tuesday, the 2nd inst., was the anniversary of the foundation of this Institution, which was founded in 1818 and incorporated in 1828. The Institution consists of three classes—members who must have occupied responsible professional positions for at least five years; associates, not necessarily engineers; and honorary members and students. Of each class there are 882, 1609, 14, and 433 respectively, making a total of 2937.

RATING OF THE EXETER WATER COMPANY.—At a special sessions held at Exeter last week, for hearing appeals against the poor-rate, the Exeter Water Company made two appeals against the increased rating of their property in Trinity and St. Mary Major's parishes. Mr. Buckingham, their solicitor, said the company had lately been assessed at a much higher rate in Trinity parish, but it had been found to be an error. He had gone thoroughly into the matter with the overseers and churchwardens of that parish, and the latter were willing to let the rate be reduced from £513 gross and £487 net, to £260 gross and £245 net. The churchwardens, admitted the error, and the Bench allowed the reduction.

A TREATISE ON THE SCIENCE AND PRACTICE OF THE MANUFACTURE AND DISTRIBUTION OF COAL GAS.

CXXIV.

MAIN-PIPES (*continued*).

We come now to treat of spigot and socket, or, as some prefer to style them, spigot and faucet joints. This is the class of joint, in one form or another, most commonly in use for gas-mains; and, taking into account the various advantages it offers over others in point of cheapness, facility in connecting, and permanent durability when well made, it may with confidence be pronounced the most suitable for adoption.

There are two distinctive kinds of this description of joint—viz., the open, and the bored and turned. It is of the former that we shall first speak. Pipes so manufactured have the inner diameter of the socket larger than the outer diameter of the spigot; the latter, consequently, fits loosely into the former. For cast-iron mains of the smallest size up to 8 inches in diameter, this open jointing space is three-eighths of an inch, and for larger diameters half an inch wide all round. The following are the usual depths of the socket, inside measure, for the various sizes of open-jointed gas-pipes, plugged with yarn and lead:—

Diameter.			Depth of Socket.
Up to 3 inches	. . . . .	=	3 inches.
4 to 8	„	=	4 „
9 to 20	„	=	4½ „
21 to 30	„	=	5 „
32	„ and upwards	=	6 „

For open-jointed pipes intended to be caulked with lead, the throat of the socket is cast with a slightly thicker body of metal than the rest of the pipe. This is necessary in order to enable it to resist the tendency to splitting in the setting up of the joint.

The spigot end of the pipe may be either plain throughout its length, as in fig. 16, or it may have a bead cast on, as shown in fig. 17.

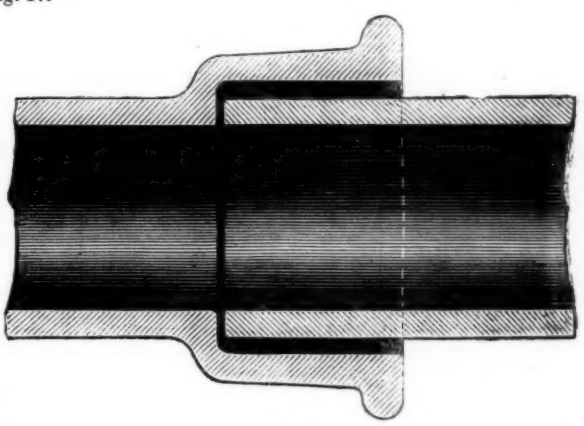


FIG. 16.

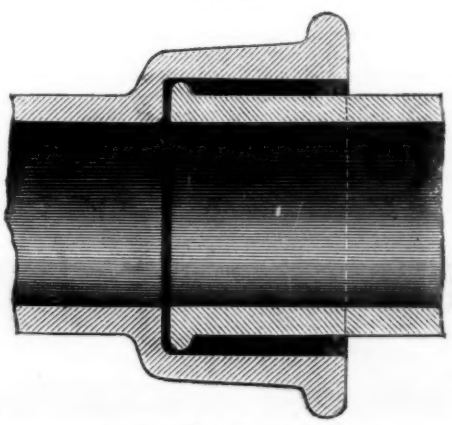


FIG. 17.

Some engineers prefer the former, stating, as their reason for the preference, that the end being plain admits of the full action of expansion and contraction without risk of the "drawing" of the lead, which they assert occurs with the beaded spigot. We do not share this view, as our experience justifies the assertion that whatever drawing of the lead may occur is due to quite another cause. In making this joint, the spigot having been inserted into the socket, a double fold of twined gasket is placed round the pipe, and, by means of a caulking iron, is driven within the open space; this is repeated three or four times, or oftener, according to the size of the mains being laid, the packing being well caulked all round, until, for a pipe say of 8 inches in diameter, the depth of the gasket is about 2 inches; the bead on the spigot prevents the packing getting beyond the pipe end. Instead of dry hemp, a packing of tarred yarn is frequently

employed. Our preference is for the former. The yarn of which it is made is usually of better quality than the other, and in absorbing the moisture which is present in the mains, it is swollen to a degree of tightness not attained in the other case. The hemp plugging not only prevents the molten lead from entering the pipe, but it allows a certain degree of play to the joint in the direction of its length, in becoming compressed by the contractile action of the metal of the pipe when submitted to a low temperature in the ground.

The packing of gasket having been inserted and properly caulked, a piece of good tough clay, formed into a roll of the required length, is passed round the pipe, and pressed close up against the face of the socket, thus forming a fence to prevent the escape of the molten lead, which is now poured in through an opening or lip, formed on the upper side of the pipe, where the two ends of the clay meet. The socket being entirely filled, the clay is removed, and the operation repeated with the other joints. The lead, after being allowed to cool, is set up all round by means of a blunt caulking tool and hammer, the superfluous lead left in the lip of the clay being cut off with a cold chisel.

When the pipes that are being laid are of large diameter, a fence of iron, which is more convenient, may be substituted for the clay roll. This is made of flat iron, 1½ inch in width, by 5-16ths inch thick, bent to fit the outer diameter of the pipe in two half circles, like a pair of calipers, and hinged underneath, the ends meeting at the top being formed into a pouring gate for the lead. The instrument is clipped round the pipe against the face of the socket, and a thin luting of clay rubbed on the edges suffices to make it tight.

It is of importance, in making lead joints, that the ladle, out of which the molten metal is poured, should be of size sufficient to contain as much as will fill the socket at one continuous pouring. If this is not convenient, owing to the large size of the joint, then two men, each having a ladle, should pour the metal simultaneously, or other means should be employed to ensure the same result. It is clear that if the lead, instead of being allowed to flow into the socket in an unbroken stream, is poured in a fragmentary way, the joint, when completed, will be less homogeneous and perfect.

TABLE

Giving the Weight of Lead in Pounds Required for Jointing Cast-Iron Mains.

Diameter of Pipe in Inches.	Weight of Lead in Pounds.	Depth of Lead in Inches.	Diameter of Pipe in Inches.	Weight of Lead in Pounds.	Depth of Lead in Inches.
1¼	1½	1⅜	11	16½	2¼
2	1¾	1½	12	18½	2⅜
2½	2¼	1⅝	13	21	2½
3	2½	1¾	14	23½	2⅝
4	4	1⅞	15	26	2¾
5	5½	1⅞	16	28½	2⅞
6	7	2	17	31	2⅞
7	8½	2	18	32½	2⅞
8	10½	2⅛	19	34	2⅞
9	12½	2⅛	20	35½	2⅞
10	14½	2¼	24	48	3

For pipes 1½ to 8 inches in diameter the lead is assumed to be about three-eighths of an inch thick; and in pipes 9 inches in diameter and upwards, half an inch thick.

The lead employed should be pure, without any admixture of tin, antimony, or zinc. We know that managers of gas-works, in laying mains, are naturally disposed to utilize the scrap composition-pipes of the store-room, and even old meter cylinders melted up together, for this purpose, with the laudable object of economizing the expenses. This is a mistake, as the more granular and brittle texture of the metals named militates against the soundness of the work.

The joint, to be as perfect as possible, should have an equal thickness of lead all round, and to ensure this being so, the spigot should be concentric with the rim of the socket. The bead on the pipe end, if of the proper size, admits of this being accomplished without difficulty, and without the necessity of temporarily wedging the pipe, though the same end is attained with plain pipes, by having the throat of the socket cast in the form shown in fig. 18.

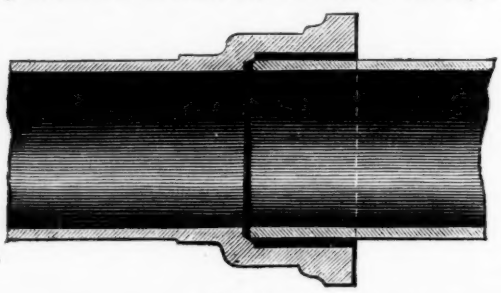


Fig. 18.

In making a lead joint, there is more likely to be oversight and neglect than in any other. Careless workmen are apt to omit the proper caulking of the lead round the under side of the pipe, which is the most difficult of access, and where bad workmanship is not so readily observed by the manager or inspector; hence the reason of the frequent escapes of gas that are found to proceed from that part of the joint.

The work, also, is in danger of being slighted from other causes. In the streets of towns, through which heavy traffic has to pass, the opening of a trench is always a source of annoyance and obstruction; and, in the anxiety to complete the work, this is sometimes hurried to a degree which is incompatible with the making of good lead joints. In loose soils, also, the workmen are under the necessity, if the joint is to be well finished, of having to make a wide cutting in its vicinity, unless shoring is resorted to, to prevent the sides of the trench from slipping. These various causes operate to place the system of the ordinary jointing by means of lead at a disadvantage, and tend in the long run to augment the leakage account.

The principal advantage claimed by the advocates of the lead joint over the turned and bored, is the superior elasticity of the former, whereby it is enabled to adapt itself to the exigencies of settlement or subsidence in unstable ground, with less risk of leakage. Whilst admitting this to some small extent, we still believe that the alleged advantage is more fanciful than real. Wherever a depression of the ground takes place by which the pipes are carried down with the movement, a leakage, or leakages, inevitably occur. This is found to be the case whether lead or turned and bored joints are employed, with this difference, however, that with the lead the gross leakage is distributed over a number of joints, and is less readily detected; whereas, with the turned and bored, it is generally either confined to one or two, or a fracture occurs at the weakest part in the line of mains, the concentrated nature of the escape (so to speak) ensuring its speedy discovery and remedy.

For our own part, then, supposing there to be no alternative, we prefer the more rigid joint, even for treacherous ground, taking the precaution, however, to have the pipes made considerably stronger than under ordinary circumstances is necessary. We have said "supposing there to be no alternative;" such, however there is, as we shall endeavour to show in a future article.

In a report to the New River Company, by Mr. Thomas Spencer, published in this Journal in September, 1860, the principal objections to the lead joint when used for gas-mains are thus stated:—

"Take the joint of a gas-main that has been laid during warm weather, when its diameter and length are at their maximum. As soon as the coldest weather sets in, the size of this main, including its joint, will have reached its minimum. But in its progress from the one extreme to the other, it is evident that the joint must undergo disturbance, even though the lead and iron should expand and contract in an equal ratio. Unfortunately, this is far from being so, for the differential rate of expansion between cast iron and lead is as 9 to 3½. In other words, the temperature necessary to increase a given length of cast iron 9 inches, will increase a similar length of lead only 3½ inches. It will now be obvious that a chief defect of the lead and iron joint for gas-mains arises from the important physical difference in the nature of the two metals. Notwithstanding the disturbance to which this joint is subjected by changes of temperature, it is clear that if the metals composing it contracted and expanded in equal ratio, less injury would arise in practice. We see, however, that the lead and iron are each contracted to a minimum in winter; but as the contractile power of the lead is not equal to that of iron, it is obvious the latter, in contracting, will press the softer metal into a less diameter than it would have assumed naturally. On the return of warm weather, when the iron portion of the joint becomes expanded to its original diameter, *that originally belonging to the lead is never recovered.* Consequently space is left, between the iron and the lead, sufficiently large to allow of the constant escape of which we complain."

We entirely concur in these remarks, borne out as they are by every-day experience and observation.

Instead of lead, iron cement is frequently employed in plugging open-jointed mains. This is slightly more expensive than the lead, owing to its occupying more time in the manipulation; but in point of permanent efficiency it surpasses the other. The cement is prepared as follows:—

98 parts fine cast-iron borings.
1 part flowers of sulphur.
1 part sal ammoniac.

When required for use, mix with boiling water. This cement sets quickly. If required to set slowly, which makes the better joint, let the ingredients be in the following proportion:—

197 parts fine cast-iron borings.
1 part flowers of sulphur.
2 parts sal ammoniac.

Mix the whole together thoroughly by pounding, and keep dry. When required for use, add hot water till the cement is of the consistency of mortar. The iron borings should be perfectly free from oil or grease.

Russian tallow and beeswax, melted and poured in between two gasket coils, have been tried as a substitute for lead, but with no very satisfactory result.

(To be continued.)

Price of Gas at Preston.—At the Preston Town Council meeting on the 1st inst., Mr. Dobson stated that, until a few months ago, the price of gas in that town was about the lowest in Lancashire, and the gas company allowed a discount of 5 per cent. more than was fixed by Act of Parliament. The quality of the gas supplied, too, had been from 1½ to 2 candles more of illuminating power than was fixed by the Act, which was 18 candles. He was glad to state that the gas company had now resolved on making an immediate reduction even in the present price. The charge had hitherto been 4s. 2d. per 1000 cubic feet, and an allowance of 15 per cent. was made to the smallest consumers, and one of 20 per cent. to the largest consumers, making the net price 3s. 6½d. per 1000 feet to the former and 3s. 4d. to the latter. But the company had now reduced the price to 3s. 9d. per 1000 feet, gross charge, which, with the allowance of discounts as before, would reduce the net charge to 3s. 2½d. to small consumers, and 3s. to large consumers.

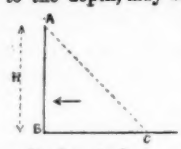
FRENCH PRACTICE IN THE CONSTRUCTION OF GASHOLDERS.

By M. Arson, Engineer-in-Chief of the Paris Gas Company.
[Translated expressly for this Journal by Dr. W. Pole, F.R.S., Mem. Inst. C.E.]

(*Continued from page* 13.)

Pressure of the Water.

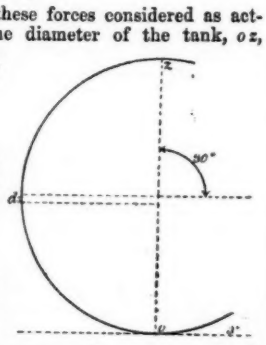
The pressure of the water on the inside of the tank is found by well-known rules. Taking an elementary vertical strip of the internal surface, whose width is $= dz$, and height $= H$, supposing the tank full, this strip will sustain a horizontal pressure $= 1000 \frac{H^2}{2} dz$ kilogrammes. To find the tendency of this pressure to tilt over the corresponding elementary piece of the tank wall, it must be recollected that the pressure of the water, varying in proportion to the depth, may be represented by a right-angled triangle thus—



and that the whole may be considered as acting at the centre of gravity of the triangle—*i.e.*, at one-third the height $= \frac{H}{3}$. Hence the moment of the pressure tending to overturn the elementary piece of tank wall about the point B will be (where S is the weight of a cubic unit of water)

$$= S \frac{H^2}{2} dz \times \frac{H}{3} = S \frac{H^3}{6} dz$$

Summing up, now, the whole of these forces considered as acting parallel to each other along one diameter of the tank, oz, and making $D =$ the internal diameter, we have, for the total force of the water—



$$= SD \frac{H^3}{6} \qquad (1)$$

The resistance opposed to this is three-fold—that of the rammed-earth backing, that of the weight of the masonry, and that of the cohesion.

Resistance of the Earth Backing.

It has been found, in the preceding section, that this will furnish, according to its nature and preparation, a resistance varying from 4400 kilogrammes to 10,000 kilogrammes per square mètre, at any depth desired.

If this resistance be represented by C, its total amount projected on the axis, oz, will be $= CD^1 H$, D^1 being the *external* diameter of the masonry.

If the backing were loose, the point of application of its resistance would be at one-third its height; but the effect of ramming will be to lead to an equality of pressure in the layers at all heights; hence the resultant point of application will be at half the height, and the moment of resistance of this element will be

$$= CD^1 \frac{H^2}{2} \qquad (2)$$

Resistance of the Weight of the Masonry.

If P represent the weight of a cubic unit of the masonry, and E the thickness of the wall, then the weight of a unit length of the wall will be $= PHE$. The moment of this round its outside edge will be $= \frac{PHE^2}{2}$ and this is the resistance it will offer to a horizontal force tending to tilt it over. Summing this up for the whole diameter, D^1, the resistance from this will then be

$$= \frac{PE^2 D^1 H}{2} \qquad (3)$$

Resistance due to Cohesion.

To crack the tank into two halves, two areas of wall, each equal to HE, must be severed. If, then, K = the cohesive force per square unit, the resistance to severance will be $= 2\,KHE$; and as this may be assumed to act at half the height to prevent overturning, the moment of resistance due to this element will be

$$= KH^2 E \qquad (4)$$

Adding these together, the combined resistance from the three sources will be (2, 3, and 4)

$$CD^1 \frac{H^2}{2} + \frac{PE^2 D^1 H}{2} + KH^2 E$$

And to produce stability of the tank these must be greater than the effect of the pressure of the water—

$$SD \frac{H^3}{6}$$

With respect to the values of the various quantities contained in the equations, the weight of a cubic mètre of masonry is approximately—

For brickwork	1800 kil.
„ rubble	2200 „

The force of cohesion will be treated of under the next head. In the meantime, it may be taken at about 150,000 kilogrammes per square mètre.

S, in French measure, = 1000. The value of C has already been explained.

The internal diameter, D, and the height, H, are usually settled beforehand. The thickness of the wall, E, is generally determined at first by other considerations of design, but this is the element to be tested by the formulæ. The external diameter, $D^1 = D + 2E$.

The constants, therefore, used in the equations will stand as follows. In French measure, the dimensions must be taken in mètres, and the weights in kilogrammes; in English, the dimensions must be in feet and decimals, and the weights in pounds:—

		French Measure.	English Measure.
S =		1,000	62·5
C =	Sand	10,000	2,050·0
	Earth, with gravel	4,400	900·0
P =	Brick	1,800	112·0
	Stone rubble	2,200	137·0
K =		150,000	30,700·0

Example.—The following shows the application of these formulæ to the tank of the gasholder No. 13 at the works at Villette. The dimensions are—

		Mètres.	Feet.
D	=	56·00	184·0
E	=	1·38	4·5
D^1	=	58·76	193·0
H	=	12·70	42·0

The masonry is rubble stone; the earth filling is punned sand.

Working out the various equations with these constants in French measures, the following results are obtained:—

(1) Effect of the pressure of the water	19,114,000
(2) Resistance of the earth backing .	47,387,000
(3) Resistance of the weight of the masonry	1,560,000
(4) Resistance of the cohesion of the masonry	33,609,000
Total resistance	82,556,000

So that the elements of resistance are four times as great as are necessary, and the structure has an ample margin of strength.

[It is an instructive modification of the foregoing calculation to estimate separately—

A, the resistance of the masonry and backing to the outward pressure of the water; and

B, the cohesive resistance of the wall of the tank to the force tending to burst it open (like that of the steam in a cylindrical boiler).

A. For the former, the moment of outward water pressure on a unit of length of wall will be $= \frac{SH^2}{3}$; and the resistance due to the masonry and backing will be $PE^2 + CH$. If these exceed the pressure, the wall will be stable independently of any aid from the cohesion.

In the Villette case, using English measures—

$\frac{SH^2}{3}$	=	37,000
$PE^2 + CH$	=	89,000

showing a good margin of safety.

B. The force tending to burst the tank open increases with the depth. At any depth h, the bursting force will be, on a unit of height $= S\,h\,D$.

This will be resisted by the cohesion of the two walls, which, per unit of height, will be $= 2KE$.

In the Villette case, at the bottom of the tank ($h = H$)—

SHD	=	490,000
2KE	=	276,000

showing that in a masonry tank the cohesive force *alone* would not be sufficient to resist the bursting force of the water. The real element of resistance is the earth backing, to which the weight and cohesion of the masonry are only adjuncts of minor importance.

The cohesive force of brickwork, or of coursed masonry, is very much increased by the plan, common in this country, of inserting layers of hoop-iron bond.

In the case of iron tanks above ground, this latter calculation becomes the important one, as the structure depends on the cohesive resistance for its strength and stability.—Trans.]

III.

The Cement Tank-Lining, and Cements and Mortars in General.

The foregoing calculations will establish the stability of the wall of a gasholder-tank; but, in addition to this, it must satisfy a second condition not less important; it must be perfectly water-tight.

This condition is obtained by a coating or lining of cement applied over the interior. The masonry itself would not suffice, alone, to retain the water; the stones are not sufficiently regular, nor are the interstices filled with sufficient perfection. Hence the necessity of the cement coating.*

The coating is executed with a composition made of Vassy quick-setting cement, in the proportions of one volume of sand to one of cement. It is spread over the whole interior of the tank, and smoothed down on the surface.

It will be interesting to explain the processes employed (A) for

* It is singular that no allusion is made here to *clay puddle*, the most common mode adopted in England for making earth and masonry structures water-tight. We must assume it is not in frequent use in Paris. Probably the clay is difficult to obtain.—Trans.

testing the quality of the cements, (B) for the preparation of the coating composition.

A.—*Cements in General.*

[Here follow details as to various kinds of cements manufactured in France. It is unnecessary to give these in full; it will suffice to make a few extracts.]

The Portland cement made at Pouilly, in Burgundy, contains 61 per cent. of lime, of which 2 per cent. is in a free state, the remainder being combined with the clay. It is slow-setting, the maximum tenacity is obtained in that which sets completely under water after six or eight months. The following examples are given of its strength:—

A *briquette* of pure cement, kept under water six weeks after being made, broke with 12 kilogrammes per square centimètre (170 lbs. per square inch). A similar one, kept eight months under water, broke with 31 kilogrammes (440 lbs.).

Mortars made of cement harden quicker in the sun and in the free air than under the action of moisture. Thus the internal coating of a gasholder has already acquired great hardness, while the interior of the masonry is not yet set, and will easily break under the hand. But the rapidity of setting always detracts from the final strength and impermeability. This is one of the reasons why the interior surface of the masonry ought to be protected from the sun, and constantly kept watered till it receives the coating.

The degree of pulverization also influences the rapidity of setting.

The weight of the best cements varies between 1350 and 1550 kilogrammes per cubic mètre (84 to 97 lbs. per cubic foot); it will sometimes reach 1600 kilogrammes.

Cement Mortars.—The following precautions are used in the preparation and use of the mortars:—

The proportion arrived at is three of fine sand to one of Portland cement.

The mortar is mixed with an excess of water, and then left on a smooth floor before use, during a time varying from one to four hours, according to the age of the cement employed. On this it rejects its excess of water, for which a discharge must be provided. The mortar gradually assumes consistence, and when it has become pasty it is fit for use.

This condition is essential for obtaining masonry well bound together, and approaching as much as possible the state of solid stone. In certain constructions, where the mortar had been used too fresh, and, consequently, too tender, it did not resist the pressure of the stones upon it, and the joints were found bare.

Every stone must be wet immediately before being fixed.

Quick-Setting Cement.—This, made at Vassy, contains 58 per cent. of lime, of which none is free. It weighs 800 to 1200 kilogrammes per cubic mètre (50 lbs. to 75 lbs. per cubic foot); 1000 kilogrammes is considered satisfactory.

Tests of Cement.—In order to test the permeability of cement, circular plates are made of a thickness corresponding to the coating they represent—say from 2 to 10 centimètres. They are placed in frames having a connexion with a hydraulic press, by which water is forced with a known pressure against one face of the plate; the other face is open to observation, so as to watch the penetration of the water through the mass. These trials are chiefly made with the quick-setting cements which are most generally used for lining the tanks.

The tests for strength are chiefly applied to the slow-setting cement. *Briquettes* are made, having a section 4 centimètres (1½ inch) square, and enlarged at the ends; these are pulled asunder by a weighted lever in the usual way.

The particulars and results of many experiments under different circumstances on both these data are stated in the paper.

Proportion of Sand.—Experience has led, for quick-setting cement, to equal volumes of cement and sand. This is the mixture which gives the strongest result—namely, 14 kilogrammes per square centimètre (200 lbs. per square inch). Pure cement is weaker, about 10 kilogrammes (142 lbs.).

For the Portland, or slow-setting cement, more sand is used. Equal volumes give a tenacity of 30 kilogrammes (428 lbs.); two of sand to one of cement gives 19 kilogrammes (271 lbs.); and three of sand to one of cement gives 10 to 12 kilogrammes. This latter is sufficient for massive work, and, consequently, the proportion of three to one is adopted for the mortar for gasholder-tank walls. [The strength adopted in the theoretical calculations is 15 kilogrammes per square centimètre, equal about 215 lbs. per square inch, or 30,700 lbs. per square foot, as previously given.]

B.—*Cement Coating.*

This is the most delicate part of the work, and is very important for the perfection of the tank.

The coating is made from quick-setting cement, with an equal volume of sand.

Its thickness should vary according to the pressure of the water. For large gasholders, which are 13 mètres (43 feet) deep, it should be 8 centimètres (3⅛ inches) thick at the bottom, diminishing to 3 centimètres (one inch and 3-16ths) at the top.

In order to keep the finished surface vertical, the main wall is made to overhang a little, to make up this difference in thickness.

The bottom of the tank is also laid with masonry, forming a sloping apron, and this is coated with cement in the same manner as the sides.

When the lower part of the excavation contains springs, which cannot be all blinded, their waters must be re-united in a small drain tank, and pumped out during the whole time of construction. (This was done at the gasholders of Les Ternes and Passy.) It is very important to maintain constantly the level of these waters below the upper surface of the apron, otherwise they may cause the cement coating to blow.

The drain tank above mentioned is built in masonry and cemented all round, the cement being united to that of the apron. A cast-iron pipe is laid in the well, and concreted round, so that the water of the springs can have no other issue than through the pipe. It is terminated by a planed surface, on which a flap-valve is fitted. When the tank is to be filled, the water of the springs issues at first into the tank, but when the water has risen in this to such a height as to balance the pressure from the springs, the flap-valve shuts. The filling is then continued from the exterior, and the tank water becomes completely isolated from the subsoil. If the cement coatings are sound, and the valve is tight, there need be no leak. The operation was successfully performed in both the cases cited.

The coating composition is thrown by the plasterers upon the surface of the masonry; its adherence is effected partly by the "keys" arising from the roughness of the masonry, and partly from the peculiar way in which it is applied.

The coating is executed in circular areas upon the apron, and in successive rings upon the cylinder, each 1·50 mètre (5 feet) in height. The junction between the apron and the wall presents a throat or gusset, with the angle filled in.

The junctions or solderings (*soudures*) of the parts of the coating successively laid on are effected as follows:—The upper part of the ring already done is sloped off to an inclined plane. The surface thus prepared is carefully brushed, in order to remove all dust or foreign substances; it is then washed, and the composition is thrown upon it to commence the following ring.

As the coating is executed, the plasterers work the surface perfectly smooth. It is found by experience that this operation contributes incontestably to rendering it water-tight, for in some of the testings the water penetrated through the body of the cement, but was stopped at the smooth surface. If the junctions are well executed, there ought to be no danger of leakage.

There are, however, some weak points that require attention. Leaks, for example, may take place where the guides are cramped into the masonry. In order to avoid this as much as possible, the cramping is executed in stone, set in cement, the same as used for the coating. The whole line of guides is first applied in one length, in its definitive position, according to a previous equal division of the circumference into as many parts as there are guides. These are then fixed and cramped in their places before the coating is laid on. The cavities left in the masonry, to receive the cramps, are filled with fragments of stone and cement, in such a way as to form a solid mass, in which the support of the guide is buried. It must be recollected that the cement does not unite well with iron, and, moreover, if the union were perfect at first, there is always danger of subsequent disturbance by vibration.

In all other places the cement coating must be made to cover everything, and no joint of the coating ought to correspond with the edges of any cavity that has been filled.

Finally, the stone blocks or "dies," which are disposed on the apron, to support the scaffoldings and the guides, constitute also weak points in regard to leakage; and, accordingly, in them also, great care must be taken to unite perfectly the cement coating with the vertical surface of the stones.

IV.

THE BELL AND ITS GUIDE-ROLLERS.

A.—*For an Ordinary Single Gasholder.*

The bell of an ordinary gasholder is formed by a cylinder, closed at its upper end by a spherical segment or crown.

Crown.—The form of this latter portion is useful to allow the rain to drain off, but it is indispensable in order to diminish the tearing force on the rivetted joint which unites the last row of crown plates to the angle-iron ring (*cornière*). When it is considered that this joint must transmit to the cylindrical sides the pressure under the crown which supports the weight of the cylinder, it will be seen that these plates ought to have as great an inclination as possible.

It is obviously also desirable to give to the first row of crown plates a thickness greater than the rest, and to make the external joint exceptionally strong, which is done by using two rows of rivets rivetted hot. The condition of rivetting hot is solely due to the size of the rivets, which would render them difficult to rivet cold; but it is not favourable to good work, rather the contrary. The rivet fixed hot cools quickly in every part which is in contact with the plate; the portion which projects, and which ought to form the rivetting, keeps relatively hotter; it is even heated by the hammering, and it supports all the mechanical battering action. It expands under the hammer, while the body of the rivet resists, whence it happens that the rivet fixed hot does not easily fill the hole in the plate, while the rivet fixed cold swells out within it, and produces a more perfect closing.

Cylindrical Sides.—The upper row of side-plates is also thicker than those below, not only in order to give a stronger attachment to the junction angle-iron ring, but to form a more substantial base for the attachment of the guide-rollers.

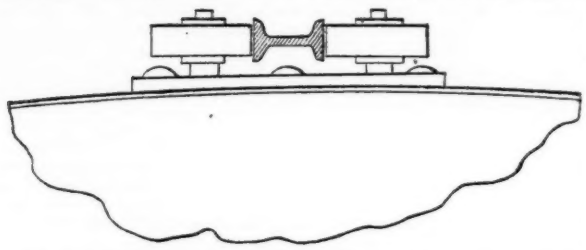
The same applies also to the bottom row of plates, and this is the more necessary here, because this row cannot be painted, being always immersed in the water.

The base of the bell must further be strengthened by some feature which will keep it in shape. If the bell encounters an obstacle to its motion in any point of its circumference, it tends to continue its movement, and will be deformed. The rollers may then escape from the guides, and the bell assume an oblique position. This can only be prevented by strengthening the lower part of the cylinder.

With this view it is customary to apply to the interior a stiffening ring, which fulfils, in regard to this portion, the same office as the roof does to the upper end.

In the gasholder No. 13, at Villette, this stiffening ring is formed by two horizontal plates, 2 mètres (6·6 ft.) wide, and 7 millimètres ($\frac{1}{4}$ in.) thick, united by a third plate, 1 mètre high, forming a vertical cylinder concentric with that of the bell. The horizontal plates are pierced with large openings, by which the water enters and discharges during the displacement of the bell, which is very slow.

Guide-Rollers.—[It should be explained that the system of guide-rollers adopted in the French gasholders differs materially from that common in England, being what is called the "tangential" system. Instead of one roller, placed in a *radial* plane, and bearing outwards on the guide-bar, there are two rollers, placed in a *tangential* plane, and bearing laterally, one on each side of the guide-bar, thus—

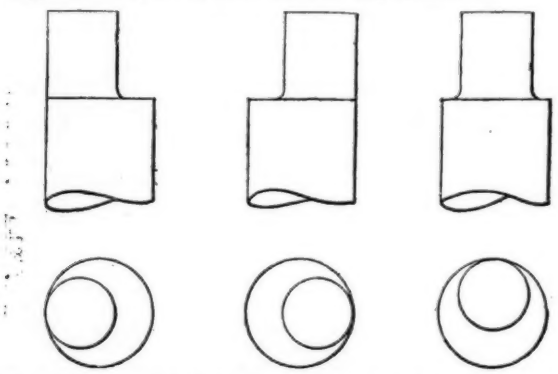


This plan, while it gives equally efficient guiding to the bell, brings the strains on the guide-bars in a direction which, from the disposition of the bracing, they are better calculated to withstand. I find the preference for this plan very strong among the French engineers.—TRANS.]

The guide-rollers, which are applied at the top of the bell, are fixed on the cylindrical side, and not on the crown. This position, on an inflexible body, allows of their being mounted during the construction, and ensures a fixedness that would not be obtained on the spherical roof surface, which alters its shape according as the gasholder is or is not under pressure.

These rollers ought to be constructed and fixed with a strength which will enable them to transmit from the bell to the guides the enormous pressures which the bell receives from the wind. Cast iron and bolts ought, as much as possible, to be excluded from these constructions; cast iron because of its brittleness, and bolts because they do not give, on the thin plate, attachments sufficiently strong and tight.

The support common to two tangential guide-rollers, as in the Villette gasholder, No. 13, is constructed of plate and angle iron, and is of such dimensions as to call into action the resistance of a large surface of plate. The axles of the rollers are of wrought iron, and of a sufficient diameter to transmit safely the pressure to the guides. These axles are formed of two cylinders of different diameters, formed in one piece of iron, but placed eccentrically, so that, in fixing them, it is possible to vary the distance between the rollers and the guides without being bound by the fixedness of the supports. They are shown in the following figures:—



They may be fixed beforehand, without caring about the exact position which they are finally to occupy.

The rollers may be dismounted and their axles removed and replaced, if necessary, while the gasholder is in action. The supports rivetted to the bell are alone immoveable.

Angle between the Cylindrical Sides and the Slope of the Edge of the Crown.—The angle iron which unites the side plates with the spherical crown of the bell ought to satisfy certain conditions of strength which it is useful to analyze, in order to determine the dimensions at this point, of the angle iron, the sheet iron, and the rivets.

If we consider the state of equilibrium of the bell while it is held up by the pressure of the gas, we shall see, in the first place, that the weight, P, of the entire bell is equal to the total pressure of the gas vertically upwards; or, in other words, equal to the pressure of the gas per square unit, multiplied into the transverse sectional area of the cylinder.

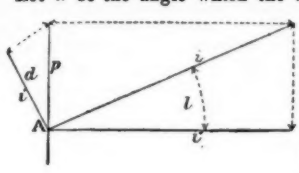
Moreover, the total weight of the bell, P, is equal to the sum of the weights, $P' + P''$, of the crown and of the sides.

The weight, P′, of the top is supported by a portion of the total upward gas pressure, the remainder of which goes to support the weight, P″, of the sides. Consequently, the angle iron, uniting these parts will only have to transmit from the crown to the sides the forces necessary to generate a vertical component equal to this weight. It thus becomes necessary to submit the connexion of these parts to an examination, based on the conditions of strength which they should present.

The part which concerns the sides may be neglected, for the rivets here are only subject to a shearing stress, and it can scarcely happen that the weight of the sides is sufficient to cause any apprehension as to the strength in this direction.

But it is different with the junction of the crown with the angle iron, on account of the great obliquity of the forces in action.

Let α be the angle which the slope of the crown makes at A with the horizontal. Let p represent the vertical component, equal to the portion of weight of the sides which corresponds with a unit of the circumference.



Then the tension, t, on the sheet iron will be—

$$t = \frac{p}{\sin \alpha} \qquad (1)$$

and this value, t, will express at the same time the force which tends to shear the rivets.

The tensile stress acting on the rivets in the direction of their length will be—

$$t' = p \cos \alpha \qquad (2)$$

The horizontal component will be—

$$t'' = t \cos \alpha = \frac{p}{\tan \alpha}$$

This force has no value in a vertical direction; it is an elementary component which must be integrated to find its value and operation.

The expressions, t, t', and t'', enable us to ascertain whether the dimensions of the parts are sufficiently strong. Their values are deduced from the dimensions of the bell, and the pressure of the gas above the atmosphere, h.

The elementary weight, p, is equal to the weight P″ of the sides, divided by the circumference; or, if D = diameter—

$$p = \frac{P''}{\pi D}$$

Consequently, the equations (1), (2), and (3) become—

$$t = \frac{P''}{\pi D \sin \alpha}$$

$$t' = \frac{P''}{\pi D} \cos \alpha$$

$$t'' = \frac{P''}{\pi D \tan \alpha}$$

These equations will clearly show the importance of the angle of inclination, α, which the exterior ring of the crown makes with the sides. If the line of the roof were horizontal, so that $\alpha = 0$, the tension on the crown plates would be theoretically infinite. For this reason, the angle should not be made too small; and several unfortunate examples have shown the desirability of giving it as large a value as possible.

At the request of the Parisian Company, the forges of Chatillon and Commentry have provided rolls which will produce angle iron of large size, 0·13 × 0·13 m. ($5\frac{1}{8} \times 5\frac{1}{8}$ inch), formed with an angle not of 90° as usual, but of 104°, which gives $\alpha = 14°$.

With this angle, $\sin \alpha = 0{\cdot}24192$, and $t = 4{\cdot}13 \frac{P''}{\pi D}$

The component, t'', is exerted in the direction of the radius, and is not of immediate importance; but the summation of its elementary values will determine the compressive force exercised on the transverse section of the metal. This will be $= t'' D = \frac{P''}{\pi \tan \alpha}$

Application to the Gasholder No. 13 of the Villette Works.

As an example of the use of these formulæ, they may be applied to test whether the dimensions given to the parts in question in this gasholder are sufficient.

Tension on the Iron of the First Tier of Plates of the Crown.—The weight P″ of the sides is 139,974 kil. (say, 140 tons), and its diameter is 55 mètres (180 feet). Thus—

$$t = 4{\cdot}13 \frac{139{,}974}{3{\cdot}14 \times 55} = 3347 \text{ kil. } (= 3\tfrac{1}{2} \text{ tons.})$$

Now the sheet iron has a thickness of 8 m.m. (0·315 inch); it is rivetted to the angle iron by two rows, each of 12 rivets (in the mètre—*i.e.*, 3·3 inches apart). These rivets, which have a diameter of 0·018 (0·71 inch), leave between them a width of solid plate per mètre = 0·784 (31 inches), so that the sectional area of resistance is 6272 square millimètres (9·8 square inches); and as each millimètre may support with safety 7 kil. ($= 4\frac{1}{2}$ tons per square inch), the total disposable resistance is 43,904 kil. (44 tons), which gives a large margin of safety.

Shearing of the Rivets.—The rivets will resist a shearing stress equal to 8-10ths of the stress capable of breaking them by tension.*

* The ordinary English rule is that the shearing strength is equal to the tensile strength.—See Pole on "Iron as a Material of Construction," Art. 88. The French rule is, of course, safer.

Each mètre of the angle iron is connected to the plates by 24 rivets as above described, the combined area of which is 0·00613 square mètres (9·5 square inches), and the safe strength will be $= 6103 \times 7 \times 0{\cdot}8 = 34{,}176$ kil. (34 tons) as opposed to a stress of 3347, which is amply strong.

Rupture of the Rivets by Tension.—The strength of the rivets will be, as just given, $= 6103 \times 7 = 42{,}721$ kil. (42 tons).

The tension on them, found by equation (2), will be—

$$t' = \frac{139{,}974}{3{\cdot}14 \times 55} 0{\cdot}97 = 786 \text{ kil. } (\tfrac{3}{4} \text{ ton.})$$

very much below the safe strength.

Strength of the Angle Iron to Resist Crushing.—By equation (3) the crushing force is calculated to be 180,000 kil., and it is spread over the entire section of the bell made by a vertical plane passing through the axis. But the sides should be excluded from effective resisting area, leaving only the section of the crown and angle irons. These two amount to 344,560 square millimètres, which gives a stress of 0·536 kil. per square millimètre ($\frac{1}{3}$ ton per square inch). The angle iron alone would offer a section almost strong enough to resist this pressure without deformation.

[The above equations may be simplified. The angle, α, will be in any case so small that we may assume, without any great error, the sine and tangent to be equal to the arc, and the cosine = 1. Hence the equations become—

$$t = t'' = \frac{P''}{\pi D \alpha}$$

$$t' = \frac{P''}{\pi D}$$

Or, putting α in degrees, and giving the numerical value to π, we have the following rules:—

Let P'' = weight of the sides in tons.
„ D = diameter of the gasholder in feet.

α = angle which the edge of the roof makes with the horizontal, expressed in degrees. Then—

1. The tensile stress on each foot of length of the top plate of the sides will be, in tons, $= \frac{P''}{3{\cdot}14\ D}$

This will also be the stress tending to shear the rivets in one foot of length, attaching the side plates to the angle-iron ring.

2. The tensile stress on each foot length of the external plate of the roof will be, in tons, $= 18{\cdot}3 \frac{P''}{D\alpha}$, which will also express the force tending to shear the rivets in each foot of length attaching the roof plates to the angle iron.

This clearly shows the disadvantage of giving too small a value to the angle, α.

3. The tensile stress tending to pull asunder the last-named rivets in each foot of length will be, in tons, $= \frac{P''}{3{\cdot}14\ D}$

4. In regard to the strength of this part to resist crushing, or rather buckling (for it would buckle before it would crush), the French paper takes the whole crown to be effective in resisting the compressing force; but on account of the thinness of the plates, and their liability to buckle, it would be safer to rely on the angle piece only. The compressive force on this will be—

$$= t'' D = 18{\cdot}3 \frac{P''}{\alpha}$$

—Trans.]

(To be continued.)

Correspondence.

STRUCTURE OF RETORTS.

Sir,—I endorse, from long experience, the views of your "snappish" correspondent, that it is not good to minimize the quantity of brickwork in a setting of clay retorts, either on the score of economy in fuel, or of the producing power and durability of the retorts.

There is another fallacy with regard to the retorts themselves, that, for the sake of the facts, and also for the sake of the gas engineering profession, needs exposing. It has been asserted that the substance or structure of clay retorts is not porous, but cellular. It is surprising to observe how the dictum of a writer or a speaker, if only it be given with a degree of self-assertion, will often be accepted without question, and for a time be received as a matter of faith by many, without the slightest examination on their part. The assertion of the cellularity of retorts is one of those dicta, for which there is no foundation in fact. If any one will take the trouble to examine the structure of a well-made retort, he will see at once the fallacy of the statement; and if he will consider the question he will soon further perceive that there is not only no necessity for this alleged cellularity, but that the presence of any visible interstices in the structure of a retort is a positive disadvantage.

On the other hand, there can be no doubt whatever of the porosity of the substance of which retorts are made—whether they be clay or iron. The only question is as to the closeness of the pores. To test the truth of this, it is only necessary to apply the requisite hydrostatic pressure, when the outer surface of the retort will be found beaded with the moisture that has been forced through the pores from the inside. This porosity is in no way inimical to the production of the gas. The pressure inside a retort in ordinary working is never such as to cause leakage through the pores.

But it may be asked, "How is it that the more friable a retort the better?" We do not admit the truth of the proposition which alleges that the more friable a retort is, the better. The more granular the structure of the substance of a retort, the better; and the more solid this granular structure the better still.

The friability of retorts, as at present generally made, is due to the imperfections in the method of manufacture; the pressure to which the material is subjected not being sufficient to consolidate its texture. It is only by the aid of machinery that the advantages of granularity with solidity of structure can be obtained.

Oh! but say the advocates of extreme friability, "If the substance of the retort is solidified to a greater extent than it is at present, there will be a contraction or an expansion (both assertions are made indiscriminately) in the material, which, when it has got to work in the oven, will lead to cracking." Both experience and common sense are opposed to this conclusion. If a retort has been thoroughly well fired or burnt, as all good retorts are, at the manufactory, no cracking of any moment will afterwards ensue on the application of heat. We have the testimony of Mr. Morton, of the London Gas Company, given in his presidential address to the last meeting of the Gas Managers' Association, that he had set 4000 feet of machine-made retorts. These had mostly been in use for 15 months, giving good satisfaction, and, as might naturally be expected, the heating had little or no effect upon them as regards expansion. This, I venture to say, is the experience of all who have tried retorts so manufactured. X.

QUANTITY OF BRICKWORK IN RETORT-SETTINGS.

Sir,—Your correspondent, "S. N. A. P.," might have been a whit less severe in his strictures; nevertheless, I agree with him as to the sophistical nature of the arguments advanced in favour of a minimum quantity of brickwork in a setting of retorts, and as to the desirability and economy of erring rather in the opposite direction.

The perfection of a retort-setting, according to the theory of some, would be to dispense with all brickwork except what might be required to support the clay retorts at the two extremities, supposing that retorts could be obtained capable of standing with only this amount of support. It would be found, however, that the temperature of the air escaping by the flue from such a setting would be greatly in excess of that from another setting having a moderate quantity of brickwork in the shape of supporting transverse walls or otherwise. This is clearly demonstrated by the construction and action of the regenerative furnace, in which a large area of brickwork is placed with the sole object of arresting and storing the heat passing through the oven.

There is no analogy, as has been shown, between the process of the production of steam in a boiler and that of gas in a retort. The regularity of the one, and the fluctuating character of the other—the thin iron plate, a good conductor of heat, in the one case, and the comparatively thick (even if only 2 or 2½ inches) retort in the other, make all the difference possible as to the desirability or otherwise of the proximity of a considerable amount of heated brickwork.

It is a common practice of some writers to set up a theory that nobody has ever broached, just that they may exhibit their skill in trying to demolish it. The argument against an excess of brickwork is a case in point. An excess is clearly unnecessary, and no one that I ever heard of advocates such a thing. Zeno.

Sir,—Your correspondent, "S. N. A. P.," does not believe in what he chooses to call "some unheard-of Belgian retorts," and asks the names of the makers of the retorts which, being supported only at the extremities, will remain intact for two or three years!

Without having seen or heard of retorts which performed such feats as this, I can inform your correspondent that there certainly are retorts made in Belgium which are amongst the most perfect in the world as regards enduring quality and finish of manufacture.

I have now before me the official report on the pottery and earthenware productions exhibited at the Vienna Exhibition of 1873, and in the section on fire-clay articles the names of two Belgian manufacturers are given, whose retorts were unquestionably the best and the cheapest exhibited. There appears to me no reason why their names should not be made known for the benefit of those who, not being afflicted with the incredulity of your correspondent, may feel inclined to make trial of their retorts. They are the "Société de Produits Réfractaires de Saint Ghislain," and the "Société anonyme de Terres Plastiques et Produits Réfractaires d'Andenne."

Having managed gas-works on the Continent, I can bear testimony in favour of dispensing with all really unnecessary brickwork in retort-settings. The cross-walls usually set with only 9 inch spaces in English settings, and carried up nearly to the arch, are universally condemned amongst continental engineers, who, it must be confessed, have given this subject much more study than has been devoted to it by English managers, and have consequently more definitely settled the principles upon which retort-settings should be constructed. The system followed is that of supporting the retorts thoroughly from beneath, while avoiding as much as possible to pile up weight on the top of them, and of leaving the sides of the retorts as far as practicable free, thus ensuring the uniform distribution of heat in the setting, and avoiding the prejudicial tearing asunder of the retorts lengthwise, which invariably occurs in consequence of the unequal expansion and contraction which ensue if the retorts are built in by numerous cross-walls.

Your correspondent evidently has in view a paper read at the meeting of gas managers in June last year, and the drawing which was exhibited on that occasion.

Without recommending the setting so exhibited, which I think very poorly represented continental practice in this particular, I feel convinced that the agitation of the question was a step in the right direction, having regard to the desirability of more definite knowledge as to what brickwork is, and what is not, necessary in setting retorts.

Belgian retorts may not be, and probably are, not better than English, but let us prove it. From my own experience I can say that continental retorts do not require all that propping up that, in the majority of cases, we give ours, and they are the better without it. I found no difficulty in obtaining 5000 feet per mouthpiece when abroad, my retorts being set with as little internal brickwork as possible, but with a front wall 1 foot thick. The statement that English or Scotch clay-retorts produce 5000 to 6000 feet per mouthpiece, with an expenditure of less than 20 per cent. of fuel, appears exaggerated, and I venture to think

it is only very rarely that an average of over 4000 feet per mouthpiece per diem is realized, and in such cases the fuel account may be considered very good which does not exceed 26 per cent. per ton of coal carbonized. G. E. S.

WET LIME PURIFICATION.

SIR,—In your last number you intimated that the wet lime system of purification "caused far worse smells than could possibly be experienced from the emptying of dry lime purifiers." Now this is not the fact. Under the wet lime system no smell was caused during the changing of the purifiers. It was all done in close vessels, and, as a rule, by merely running the charge from one purifier into another. The great difficulty was in getting rid of the "blue billy," as it was called. But even this I know was easily done at the Horseferry Road works of the Chartered Company, where a series of settling-tanks was provided, in which the thick stuff was allowed to settle down into a pasty condition. This was then burnt in a close oven, and the lime used again, while the clear liquid was burnt, or evaporated under the furnaces. I believe, with our present knowledge and means of overcoming pressure by exhausters, the wet lime process may have a chance again. A bushel of lime used in the wet state will purify double the quantity of gas that dry lime will do, and as we now take out all the ammonia from the gas before it reaches the lime, there should be no smell whatever. However, there is no doubt that oxide of iron is the cheapest and cleanest system of purification. X. Y. Z.

Legal Intelligence.

DEVON EPIPHANY SESSIONS.—THURSDAY, JAN. 4.

(*Before the* EARL OF DEVON, *Chairman, and Messrs.* HALLIDAY *and* TOMS.)

ALLEGED NUISANCE AT THE EAST BUDLEIGH GAS-WORKS.

The indictment in this case contained seven counts, which charged the company with creating noisome, offensive, and unwholesome smells; with neglecting to take reasonable and proper care, and using proper skill and precaution in carrying on their works; with using the works in a way that was neither proper nor careful; with allowing to escape thick and unwholesome smoke; with keeping on the works a quantity of spent lime, from which smells were continually emitted; with keeping a large quantity of ammoniacal liquor and gas refuse; and with allowing this liquid to flow on the highway. On each count they were charged with causing a nuisance injurious to health, from March, 1876, up to the present time.

Mr. LEWIS appeared to prosecute, and Mr. CLARK and Mr. FOOTE for the defence.

The secretary of the company not being present, through illness, the Court intimated that they would be prepared to hear any one who appeared on their behalf, and it having been proved that Mr. Toby, the company's solicitor, had been verbally authorized at a board meeting to represent them, he was allowed to do so.

At the request of Mr. LEWIS, however, the Court took a note of his formal protest that Mr. Toby ought to have appeared under the common seal of the board.

Mr. CLARK said the company had not the slightest objection to plead to the indictment if they had power to plead, but they believed their plea here would be void. The legal and proper course for the prosecution would have been, after the indictment was found at the last quarter sessions, to have removed it to the Queen's Bench by a writ of *certiorari*, when it would have been sent down in due course to be tried on the civil side at the assizes.

Mr. LEWIS pointed out that his friend had put himself in an anomalous position, for he had first called a gentleman to appear for the company, by attorney, and then he came forward and said the company did not appear at all. He submitted that this case was similar to indictments for the repair of highways, which were usually tried at quarter sessions. In such cases they could not bring up a whole parish, but they did bring some one. For himself he did not care where the case was tried, whether it was removed by writ of *certiorari*, or whether it was tried at the assizes—all that he wanted was to get the company to appear.

After retiring to consider, the Court announced that they were not prepared to give an opinion, and thought it would be better to hear the arguments of counsel as to the distinction between this case and an indictment of a parish for the repair of highways.

Mr. LEWIS, on behalf of the prosecution, said he should be very sorry to allow the Court to try a matter if there was a shadow of doubt about it. If the matter was decided in their favour, and they had to take out a distress, they might be met by an action for trespass, and it might end in the House of Lords. That there should be no difficulty in the matter, he would be willing to have the indictment adjourned, and he would take out a writ of *certiorari*.

The CHAIRMAN said he fell in with this view, that the case should be tried by a writ of *certiorari*.

Mr. LEWIS asked for the case to be adjourned till the next sessions, in order that the indictment might be kept alive.

This was agreed to, and the case, in that stage, terminated.

WIGAN BOROUGH POLICE COURT.—THURSDAY, JAN. 4.

(*Before Messrs.* WALL *and* BRYHAM.)

PROSECUTIONS BY THE WIGAN CORPORATION UNDER THE CONSPIRACY AND PROTECTION OF PROPERTY ACT.

Michael Foy, stoker at the corporation gas-works, was charged under the Conspiracy and Protection of Property Act, 1875, with breaking a certain contract entered into between him and the corporation, by leaving his work, knowing that the probable consequences of his so doing would be to deprive the inhabitants of the borough of their supply of gas.

Defendant pleaded that he left in consequence of illness.

Mr. BELL prosecuted, and said the defendant was an experienced stoker, and had been employed at the gas-works since and before the corporation bought them. His last engagement commenced about a month ago, and at that time Mr. Hawkins hired him on the understanding that a seven days notice was to be given on either side in the event of either party wishing to terminate the engagement. On the previous Saturday night, defendant came to his work for the night shift at nine o'clock, and ought to have continued at his post till five o'clock on the following morning. However, at half-past ten o'clock he refused to work any longer. Mr. Hawkins explained to him the great inconvenience his going away would cause, and how it would be difficult to maintain the requisite supply of gas; but, in spite of this, defendant put on his coat and left the works, and the consequence was that 14 retorts had to stand idle. Defendant chose the very worst time to absent himself from his work, and he (Mr. Bell) had no doubt he took advantage of it. He had been paid up to the previous Thursday, so that he thus actually left in the middle of a week.

Mr. *Hawkins*, manager of the gas-works, bore out Mr. Bell's statement, and said that defendant when he left his work said his "mate was no good," and that he would not work. He had never heard of defendant being ill until now; in fact, defendant came to the gas-works at five o'clock next morning to do another man's shift.

Mr. ELLIS (magistrate's clerk) said before the magistrates could convict in this case it would have to be proved that defendant "wilfully and maliciously" broke his contract, with the intention of depriving the inhabitants of their supply of gas. There was a difference between the Master and Servants Act and the Conspiracy Act, in so far as the words "wilfully and maliciously" were inserted in the latter, while the former only contained the word "wilfully." It would, however, be for the magistrates to say whether defendant left work "wilfully or maliciously."

Mr. BELL said the defendant was an experienced stoker, and knew well the consequences that would result from his leaving work in the way he did.

Mr. WALL said the offence was a most serious one, and the prisoner was liable to be sent to gaol for three months for committing it, but as this was the first case of the kind that had come before the Bench, defendant would be let off on payment of 10s. and costs.

Martin Grady, coke wheeler, was charged with a similar offence committed the same night.

Mr. *Hawkins* said several of the coke wheelers had left their work on Saturday night, and defendant told him he could not do the work himself, but he (Mr. Hawkins) persuaded him to remain on and do as much as he could. It seemed, however, that as soon as he turned his back defendant left the works.

Fined 10s. and costs.

WANDSWORTH POLICE COURT.—SATURDAY, JAN. 6.

(*Before Mr.* BRIDGE.)

CHARGE UNDER THE EMPLOYERS AND WORKMEN ACT.

George Gibbs and *George Emmett*, foremen in the service of the Wandsworth and Putney Gas Company, were summoned to show cause why they should not be ordered to pay compensation for damages caused through their neglect.

Mr. H. KIMBER appeared in support of the summonses.

Mr. *Henry Freeman*, engineer of the company, said that on the night of the 23rd ult. he observed the lights in Wandsworth getting very small. He ran to the works as rapidly as he could, and found both holders "landed," being empty of gas. He went to the retort-house and sent for Gibbs, the night foreman. He could not hear of him, but when he saw him he found that he was very drunk. He also found eight out of twelve men at work drunk, but they would have been able to do their work if properly looked after. It was the duty of the defendant to attend to the pressure and supply gas for the night for the whole district. By his neglect the district was in imminent danger of being put in darkness. Witness sent for Emmett, the day foreman, who arrived quickly, but he was so drunk that he found he was of no use at all.

The defendant *Gibbs*, in answer to the complaint, said he was not drunk, but when he heard that his lights were out he reeled from surprise. Being a rough night, people delayed their purchases, causing shopkeepers to burn more gas, deceiving him in his calculations. He could prove by the men that they all went to work fifteen minutes before the time.

Mr. *Freeman*, in reply to a question, said that when Gibbs found the pressure being reduced, it was his duty to check the supply, but he did the best he could under the circumstances. He added that the defendant had previously given satisfaction in his work, and bore a good character. It also appeared that both defendants had been discharged.

Mr. BRIDGE said Gibbs had shown, by his intelligence, that he must have had his wits about him. After the explanation, he advised the company to withdrawn the summonses.

Mr. KIMBER, in acceding to the suggestion, said the company felt bound to take the proceedings.

Mr. BRIDGE said they were quite right to institute the inquiry.

Two other summonses were also withdrawn.

INDICTMENT OF THE COLNE VALLEY GAS COMPANY.—At the last quarter sessions, which were held at Wakefield, an indictment was preferred against the directors of the Colne Valley Gas Company for breaking up the highways in Longwood and Golcar, and a true bill was found. The case was expected to be heard at the sessions, held at Leeds, and several persons had been served with notices, but the case has, we have been told, been removed to the Queen's Bench Division by a writ of *certiorari*. The Longwood Gas Company has been constructing a new tank for increasing the supply of its gas, but at the instance of Messrs. Hirst, Hanson, and Sons, who are large shareholders in the Colne Valley Gas Company, an injunction has been granted by the Chancery Division of the High Court of Justice against the Longwood Company and against the contractor who is doing the work, so that now the work is at a standstill. Nothing, however, seems to damp the courage of the rival companies, for whilst the Longwood Company is spending large sums in increasing its supply of gas, the Colne Valley Company has resolved to increase its capital and to build a logwood mill upon its grounds, and it has also in contemplation the erection of a large woollen mill close to its works. This week a true bill has been found by the grand jury at Leeds against the Colne Valley Company, for further breakings into the roads of Longwood and Golcar. —*Huddersfield Examiner.*

ANDOVER WATER SUPPLY.—There has been some misunderstanding recently as to the purposes for which water was to be supplied to the Andover Corporation by the water-works company, the former body contending that the supply contracted for, at £50 per annum, included water for sanitary purposes (watering the streets, flushing the sewers, &c.) and the latter body maintaining that the contract was only for water required at fires. A special meeting of the Town Council was held lately, to confer with the representatives of the water-works company on the subject, and after some consideration, it was resolved to pay the company £100 per annum for a supply of water for all purposes, the agreement to be terminable by six months notice.

GOVERNMENT INQUIRY AT ST. HELEN'S (LANCASHIRE).—The corporation of St. Helen's having applied to the Local Government Board to increase their borrowing powers from £100,000 to £250,000, for the purpose of carrying out the purchase of the water and gas undertakings, together with the several improvements authorized by the Act of Incorporation, Mr. C. N. Dalton, one of the inspectors of the board, held a court at the St. Helen's Town Hall, on the 3rd inst., for the purpose of receiving evidence in connexion with the said applications. Mr. T. Beasley, clerk to the Widnes Local Board, asked that the corporation should be restrained from carrying out their project of sinking additional wells at Cronton, that being in the limits of the Widnes water supply. The mayor, Alderman Gamble, and the town clerk disclaimed any intention by the corporation of seeking to make any new water-works under the provisional order they were now applying for. The commissioner promised that he would so frame his recommendation to the Local Government Board as to afford the Widnes Local Board the protection sought for.

Miscellaneous News.

METROPOLIS GAS SUPPLY.

Abstract of the Report of Professor Williamson, Chief Gas Examiner to the Metropolitan Board of Works, on the Results of the Daily Testings of the Gas supplied by The Gaslight and Coke Company and the South Metropolitan Gas Company, during the Quarter ending Dec. 31, 1876.

In the report for the quarter ending Sept. 30, 1876, it was stated that appeals had been made by The Gaslight and Coke Company in relation to the excess of sulphur found in the gas made at Fulham during the months of August and September last, but that sufficient evidence had not been received to decide the case. It has since been shown that, the excess of sulphur was due, on most of the occasions in question, to the fact of the purifying appliances at the Fulham works being inadequate, and that the difficulty of purifying the gas had been increased by the excessive heat of the weather. It was stated by the company's engineer that new purifiers were in course of construction.

Illuminating Power for the Past Quarter, in Standard Sperm Candles.

Description of Gas and Testing-Place.	Max.	Min.	Aver.
The Gaslight and Coke Company—			
Common gas, Beckton	18·6	15·5	17·2
,, Ladbroke Grove	18·4	15·5	16·9
Cannel gas, Millbank Street	23·2	20·0	21·0
Common gas, Devon's Road	18·3	16·1	17·0
,, Carlyle Square	19·8	16·3	17·9
,, Camden Street	17·6	15·9	16·7
,, Graham Road	19·9	16·0	17·9
South Metropolitan Gas Company—			
Common gas, Hill Street	18·0	16·0	17·1

At most of the testing-stations the illuminating power has been invariably above that required by the Acts of Parliament.

An appeal was made by The Gaslight and Coke Company with reference to the return of 15·5-candle power in the gas tested at Beckton on the 14th of November last. It was stated by the company's engineer that the result obtained by their own gas examiner on that occasion was 15·95-candle power. Evidence was produced which led to the decision being given in favour of the official examiner.

Sulphuretted hydrogen has been present in the gas made at Beckton on the 24th, 25th, and 27th of November last, and in the gas made at Fulham on the 14th of December; but has been uniformly absent in the gas made at the other works. The Gaslight and Coke Company made an appeal with regard to the presence of sulphuretted hydrogen returned in the Beckton gas on the 27th of November, with the view of showing that the impurity in question had only been present in a very infinitesimal trace; but the official gas examiner produced a piece of test-paper which showed a very distinct indication that sulphuretted hydrogen had been present in the gas on that occasion. The Gaslight and Coke Company have shown that the presence of sulphuretted hydrogen in the gas made at Fulham on the 14th of December was due to the accidental leakage of a valve in a purifier.

Proportions of Sulphur, in other Forms than Sulphuretted Hydrogen, in Grains per 100 Cubic Feet of Gas.

Description of Gas and Testing-Place.	Max.	Min.	Aver.
The Gaslight and Coke Company—			
Common gas, Beckton	19·6	5·9	12·6
,, Ladbroke Grove	16·7	11·6	14·1
Cannel gas, Millbank Street	24·6	14·0	19·0
Common gas, Devon's Road	21·6	6·2	12·7
,, Carlyle Square	23·6	9·7	14·1
,, Camden Street	25·3	10·1	14·7
,, Graham Road	16·1	10·0	13·9
South Metropolitan Gas Company—			
Common gas, Hill Street	24·3	12·3	17·7

At all the testing-stations the average of sulphur present in the gas has been considerably below the amount permitted by the Acts of Parliament. Only on one or two occasions at Devon's Road and Camden Street has the quantity present slightly exceeded that amount.

Ammonia has been present at all the stations in greater or less quantity during the past quarter. At Devon's Road, Millbank Street, Ladbroke Grove, and Carlyle Square, it has occurred only occasionally, and in small quantity. At Beckton and Camden Street it has been almost constantly present, but only in small quantity. At Graham Road the ammonia present in the gas has steadily diminished in quantity during the months of October and November, and it has been almost uniformly absent throughout December. At Hill Street the quantity of ammonia has been considerably greater than at any other of the testing-stations, and on one occasion it exceeded the maximum allowed by the Act of Parliament.

University College, London, Jan. 8, 1877.

Dr. Stevenson's report on the gas supplied by The Gaslight and Coke Company to the vestry of St. Pancras, during the month of December, 1876:—Maximum light, estimated by sperm candles, according to the Act—17·5. Minimum light, sperm candles—15·8. Average light, sperm candles—16·6. Traces of ammonia, indicated by turmeric test-paper—traces always. Traces of sulphuretted hydrogen, indicated by lead test-paper—none. Sulphur—9·02 grains per 100 cubic feet.

SALFORD CORPORATION GAS-WORKS.

A Special Meeting of the Salford Town Council was held on Wednesday, the 3rd inst.—the MAYOR (Alderman Walmsley) in the chair.

The General Gas Committee presented the following report:—

Your committee beg to report that during the past 12 months the question as to the quality, capacity, or power and suitability for the economical working of the present gas-works and apparatus has engaged their serious attention. A voluminous report and elaborate statistics, together with plans showing existing works and proposed extensions have been prepared by Mr. Hunter, the gas engineer. These show numerous serious defects, or deficiencies in the existing works, to remedy which a considerable outlay would be required, and a large and continuous increase in the consumption will also make it necessary to provide additional apparatus and buildings.

Your committee have arrived at the following conclusions, which they recommend for adoption, subject to the advice of the town-clerk as to the powers of the corporation under their local Acts, viz.:—

1. That the existing works are not good in quality or well arranged for economical working; they are not proportionate in their different parts, and are inadequate to meet present requirements. The deficiencies are principally in the condensing and purifying portions of the apparatus, which are not equal to more than one-half of the present make of gas.

2. It is not only desirable but imperative to make good these deficiencies, and for that purpose the following extensions are necessary:—

At Lamb Lane.—Additional condensers, scrubbers, or new washers, exhausters, purifiers, buildings, and storeage for tar and liquor.

At Regent Road.—Re-arrangement of works, additional condensers, scrubbers, or new washers, purifiers, buildings, and storeage for tar and liquor.

At Liverpool Street.—The condition of the retort-house and fittings requires further consideration, new stables, and tar and ammoniacal liquor tanks.

3. Your committee are of opinion that the cost of remedying the present defects, exclusive of Liverpool Street retort-houses, will amount to about £30,000, and that when they are rectified the works will be capable of manufacturing, purifying, and storing about 3¼ to 3½ million cubic feet per diem. Your committee strongly advise that as much as possible of this work should be done between Jan. and Sept., 1877.

4. Your committee have considered the necessity for a further extension of the works, and in proof of such necessity desire to lay before you the following figures, viz.:—In the year 1856 the gas made was 133,539,000 cubic feet, in 1866 it was 289,356,000, and in 1876 it was 583,470,000, showing that in every nine or ten years the consumption of gas is doubled.

5. The increase of the population, and the continued increase in the consumption of gas, warrant your committee in assuming that the make of gas will increase from 583 million in 1876 to 1000 million in 1884, and, in order to provide the additional plant required to meet the wants of the consumers, your committee recommend the following further extensions, viz.:—

At Lamb Lane.—Increase in number of retorts; alteration in retorts, fittings, and buildings; additional condensers, exhausters, scrubbers, washers, and other purifying apparatus; additional buildings and tar and liquor tanks. The works to be equal to a make of 1 to 1¼ million cubic feet per diem, and the storeage, as now, to 904,000 cubic feet.

At Regent Road.—Extension of retort-house, and increase in number of retorts; necessary condensing and purifying apparatus; additional buildings and tar and liquor tanks, except in gasholder storeage, which will remain as now. The works to be equal to a make of 2½ million cubic feet per diem.

At Liverpool Street (where at present there is no condensing or purifying apparatus).—Alteration or extension of retort-house and fittings; new condensers, exhausters, scrubbers, washers, purifiers, meters, gasholders and tanks, tar and ammoniacal liquor tanks, governors, and all necessary buildings. The works to be equal to a make of 2½ to 2¾ million cubic feet per diem, and storeage to 3 million cubic feet.

6. The cost of the above work will amount to a further sum of about £130,000, which does not include the cost of rebuilding any of the present retort-stacks and removal of the fittings. The whole of the ground now in possession of the Gas Committee will then be covered, and for further extensions additional land will be required. The capacity or power of the works will be equal to a supply of 6 million cubic feet per diem, which will meet the requirements of the consumers to the close of the winter of 1883-4.

Your committee are desirous of carrying out this work during the years 1877-8-9, 1880-1-2, and 1883, and as near as practicable in sections, or at a rate proportionate to the increased consumption of gas; as, by so doing, the capital expended will be less burdensome. The increase in the business will allow an expenditure of from £25,000 to £30,000 per annum.

It only now remains to be stated that, with a full consciousness of the importance of this report, they unanimously recommend its adoption, and ask you to resolve that the work shall be carried out. As previously stated, the subject has been before your committee during the past 12 months; and they have given most careful attention during that period to the very elaborate plans and statistics which were prepared by Mr. Hunter, fully illustrating the present condition of the three stations, and the extensions proposed by him.

Your committee, before approving of the whole scheme, and acting on the suggestion of Mr. Hunter himself, decided to call in the advice of an eminent gas engineer. The names of six gentlemen (considered to be best in the profession) were submitted, and your committee selected Mr. George Livesey, C.E., a gentleman who has lately advised the Manchester Corporation, and who is considered one of the, if not the, most economical engineer, and most successful gas manager in London.

As requested by Mr. Hunter, the whole of the plans, reports, and estimates were placed in the hands of Mr. Livesey, with a request that he would advise the corporation thereon. Mr. Livesey has now presented his report, and we are happy to say that he entirely concurs with Mr. Hunter in the necessity for the work referred to in this report, and has endorsed that the designs and mode of erecting it proposed by Mr. Hunter cannot be improved upon, and should be adopted. This thorough approval of the scheme is a confirmation of the skill and care bestowed upon it by Mr. Hunter, and is highly satisfactory to your committee.

Mr. W. SHARP, chairman of the Gas Committee, moved—"That the report of the general Gas Committee as to the proposed alterations of the gas-works now read be adopted, and that the general Gas Committee be authorized to carry out the same." He was not aware that it had been usual to submit to the council such a comprehensive scheme, requiring so many years to execute, but the Gas Committee had come to the conclusion that hand-to-hand extensions, without an eye to the future and calculations as to results, must terminate, and the opinion held was that the truest economy, and the best way of meeting the wants of consumers, was the broad basis upon which the committee were now acting. The report set forth or referred to existing works, their condition and capacity, the deficiencies and what was wanted to bring them up to the required standard to enable the committee to turn out pure gas, and work with greater economy. It entered fully into the probable increase, and what was wanted, and how the committee proposed to meet an increase which was so very large and continuous. It gave the cost and an idea of the work which would be done for the money. At the present time the purifying power at the gas-works was ridiculously small. There was certainly a large amount of carbonizing power which could be used; but it was not fair to the consumers to turn out impure gas, which they were obliged to do unless they had the purifying power increased. If the report were approved, the council would be asked from time to time to confirm contracts as they were entered into. Instead of leading the council step by step, the committee considered it best to give them a fair, and, as far as possible, a full idea of what was intended for some time to come. The committee were satisfied that as they had exercised so much care and caution before coming to the council, that they (the council) would not hesitate to approve the report, especially as it was absolutely necessary to commence the work immediately. So far as he (Mr. Sharp) was personally concerned, he might say that the subject had been discussed between himself and Mr. Hunter, the gas engineer, over and over again during the past 12 months, and feeling his responsibility, he (Mr. Sharp) had made it his business to satisfy himself first, whether the work was necessary; second, how much was necessary; third, whether the plans proposed carried out the work in an economical manner. Certainly his own experience was insufficient to warrant him in speaking in the most positive terms, but the whole of the committee were fully satisfied upon every point. Mr. Hunter had shown considerable anxiety about the matter; if any faults could be found or improvements suggested, his great desire had been to find them out before any money was spent, and not in the useless hereafter. To show his confidence in his own plans and his willingness for them to be improved upon, and further that the committee might be strengthened in coming before the council and as a satisfaction to the public, Mr. Hunter said, "Take my plans, but don't trust to your own judgment. Call in one or more of the best engineers you can find, let them advise you whether my proposals are right or wrong, for it is better to be put right at the beginning than spend money in a wrong way." Mr. Hunter refused to recommend an engineer, and the committee—no doubt influenced by what Manchester had done in selecting Mr. Livesey, and knowing that he was noted as a first-class engineer, and selling the cheapest gas in London—took his advice, and the council had heard by the report that Mr. Livesey entirely concurred with Mr. Hunter. He (Mr. Sharp) thought it was only just to the committee's own engineer to acknowledge the skill and care displayed in the preparation of plans, and the getting up of all information necessary for the committee and for Mr. Livesey, to enable the committee to arrive at the conclusion come to. He had, thereupon, great pleasure in moving the adoption of the report.

Alderman JENKINS seconded the motion, remarking that he was of opinion that if the progress of the Gas Committee now contemplated had been made some five or six years ago, they would have saved some scores of thousands of pounds.

Alderman LEE objected to the council coming to any decision that day on the expenditure of such a large sum of money. The report of the committee ought to be printed and circulated amongst the members of the council, so that they could have proper time in which to consider the matter.

Alderman M'KERROW agreed with Alderman Lee, and was surprised,

after the experience the Gas Committee had a few months ago in the matter of their contracts, they should ask the council to approve their report that morning. He suggested that the matter should be postponed for consideration, until the next meeting of the council.

Alderman DEWHURST said it was necessary something should be done. The present gas-works would only make a certain amount of gas, and they must make provision for an increased supply, or the borough would be left in darkness. The committee had had the best advice on the subject they could get, and it was what they had heard in the report that morning. They were not responsible for the evil deeds of their predecessors, but if the works were not in a fit state to make gas as it ought to be made, he thought the best plan was to begin and mend matters. He believed the proposed undertaking was perfectly sound and feasible, and he hoped the council would support the committee in the matter.

Alderman DAVIES protested against large schemes coming before the council, and the council being asked to give a decision without due time for consideration. They would not have been in their present difficulties at the gas-works if, in days gone by, they had insisted upon something of the kind. The council ought never to be taken by surprise in voting large sums of money.

Mr. SHARP urged upon the council that the works must be started with directly, and asked if the committee could not be authorized to get forward with £30,000 worth of work. He suggested that a special meeting should be called for that day fortnight, to consider the question.

After some further discussion, on the motion of Alderman DEWHURST, seconded by Mr. J. E. MIDDLEHURST, it was resolved—"That the matter be considered at a special meeting to be called by the mayor, and that in the meantime a report be prepared under the direction of the chairman and deputy-chairman, and sent out to each member of the council."

PROPOSED PURCHASE OF THE ILKESTON GAS-WORKS.

On Friday, the 29th ult., a Public Meeting of the Ratepayers of Ilkeston, convened by the Local Board, was held in the Town Hall, to discuss the question of opposing the gas company's proposed application to Parliament next session for increased powers, and to authorize the board, under the Municipal Corporations (Borough Funds) Act, 1872, to defray the expenses of such opposition (if decided upon) out of the funds of the general district rate.

The *Nottinghamshire Guardian* states that the policy of the local board, as exhibited during the past year or so, has given rise to much controversy and provoked considerable criticism amongst the ratepayers. More particularly has this been the case within the past month, on its becoming known that the board had resolved to apply for a loan of £16,000 for the purpose of improving the water supply, and that they had resolved to make overtures for the purchase of the gas-works, which would involve an outlay of something like £20,000 more. Although the water supplied by the old company is far from being as pure as it might be, and the present works of the gas company are barely adequate to meet the existing requirements of the town, the large outlay required to transfer the control of each to the local authorities naturally aroused the usually uninterested ratepayers, some of whom saw before them visions of increased rates and burdens too intolerable to be borne. Although, therefore, the chairman of the local board, in his notice convening the meeting, confined himself to stating this to be the sole object of the meeting just referred to, it was generally understood that the much more important question of the purchase of the gas-works would occupy the attention of those present. On the strength of this impression large placards were issued on the previous day, advising the ratepayers to attend the meeting and vote against the further mortgaging of the rates. The ground on which the local board were to be opposed in their intention to purchase the gas-works may be best explained by giving a copy of the bill issued by the anti-purchase party, which was as follows:—

Ratepayers of Ilkeston! If you do not at once look after your own interests, the parish will be saddled with a debt of £40,000! To prevent the borrowing and mortgaging propensities of the local board, you should attend the meeting of ratepayers on Friday night, the 29th of December, in the town hall, at seven o'clock.

The parish is now in debt for the town-hall and sewerage purposes nearly	£5,000
Other sewerage works must soon be carried out, at a cost of about . .	10,000
The board have already decided to borrow for water-works.	16,000
And propose, at the meeting on Friday next, to borrow more money to buy the gas-works, the probable cost of which will be at the least another	16,000
Law expenses in opposing the gas company	300
Total	£47,300

A debt of £40,000 or £50,000 on a parish like Ilkeston will be simply unbearable. Last year the board expended about £3000 of ratepayers money. Allow them to borrow another £40,000 or £50,000, and what will the rates amount to in the year? The rates of the Ilkeston Local Board are considerably higher than in most other districts. If the board buy or erect new water-works, we shall then have heavy water-rates, which will again increase all cottage-rents fearfully. If the board buy the gas-works, board gas will not be 1d. per 1000 cheaper to consumers than that supplied by the present company. The board do not manage with the works they have in hand. They have a number of high-salaried servants, but not one who can manage even the cleaning or lighting of the town lamps. How, then, will they manage a large works, with a capital of £16,000 or £20,000? Let us have no borrowing to buy private works until things are better managed. Ratepayers,—attend the meeting, and vote against borrowing money and mortgaging the rates!

It will be seen from the above that the financial view of the question is the uppermost, and although some of the statements contained in it may be rather exaggerated, the estimated cost of the water-works and gas-works is under rather than over the mark, the total cost of both amounting to between £30,000 and £40,000. Never since the adoption of the Local Government Act at Ilkeston—about 14 years ago—has a public meeting of the ratepayers been called by the local board until the one in question; still no scheme has previously occupied the attention of the board necessitating so large an outlay as the contemplated purchase of the gas and water works.

The chair at the meeting on Friday was occupied by Mr. W. Wade, the chairman of the board, and the meeting was crowded with ratepayers.

The CLERK (Mr. W. Lissett) having read the requisition to the board, upon which the meeting had been convened,

The CHAIRMAN said the question to be decided was of immense interest, not only to the ratepayers, but also to gas consumers and the shareholders of the gas company, and he trusted it would be discussed in a spirit of fairness and good feeling. He could sympathize with those who had, many years ago, invested their capital in a profitable undertaking, and he could readily understand their chariness when they found their profits in jeopardy. When they considered the magnitude of the gas-works, and also remembered that they had hitherto been carried on by the permission of the local board, it was natural for the company to attempt to obtain some valid authority for the exercise of their calling. The local board had to consider the welfare of the whole of the ratepayers, and it was their duty to oppose an application for powers which would enable the gas company to break up new streets, independent of the ratepayers. They proposed to supply the public lamps with gas, and to levy a rate upon the inhabitants for such supply; and if the Provisional Order asked for were granted, the ratepayers would be compelled to submit to the terms of the gas company so long as they did not charge more than 5s. per 1000 feet. If the ratepayers surrendered their rights, the shareholders of the gas company would appoint only such men for directors as would procure them the largest dividends. The local board had studied the question, and they were desirous of arriving at a just conclusion. They did not believe in the gas company being granted a monopoly and a sole right to supply gas to the parish of Ilkeston. If that were the case, they would be compelled either to pay the price asked for the gas, or go without it altogether. If any monopoly was to exist, the board thought it ought to be in the hands of the ratepayers. The board were prepared to borrow the money required for the purchase of the company's works at such a low rate of interest that they could, with the profits from the gas, pay off the whole of the principal and interest, without asking for one penny in the shape of a rate. He concluded by moving that the board oppose the application of the gas company, and that the costs of such opposition be defrayed out of the general district rate.

The proposition was seconded by Mr. W. SUDBURY, in a brief speech.

Mr. W. LISSETT, clerk to the local board, read the estimates which the board had prepared, from which it appeared that he had written to twenty different parishes respecting the profits made by the gas companies of those places, and he found that the highest was 12½ per cent., and the lowest 5 per cent. They could borrow £18,000, which he thought would be sufficient to purchase the gas-works, at 3½ per cent., and pay it back in 30 yearly instalments of £600 each. The yearly profit from the manufacture of gas would be £1350, and after paying back the proportion of the loan and the interest, there would still be money left to assist the rates. In 30 years the works would be clear, and the whole of the £1350 would be for the benefit of the ratepayers.

Mr. MELLOR wished to know what it would cost to oppose the gas company. When lawyers had a parish for their client their bills were generally long ones, and he was sure the ratepayers of Ilkeston had no money to "fool" away in law.

Mr. B. WILSON, secretary of the gas company, said the board had now four 10d. rates where there was formerly only one, and yet this was the board which promised such great boons without any guarantees.

Mr. WILLIAM SMITH supported the proposition, and was followed by others on the same side.

Eventually the motion was put to the vote, when only one hand was held up against it.

PROPOSED PURCHASE OF THE BRISTOL WATER-WORKS BY THE CORPORATION.

At the Meeting of the Bristol Town Council on the 1st inst.—the MAYOR (Alderman Edwards) presiding,

The WATCH COMMITTEE presented a long report upon the question of a proposed reorganization of the fire brigade and the purchase of the works of the Bristol Water Company. With reference to the latter point, they remarked that "it has occurred to your committee that this report presents a favourable opportunity to consider whether some of the existing difficulties may not be removed, and further advantages, which will suggest themselves to the council, secured to the city, if the corporation were to acquire the undertaking of the water-works company, provided equitable terms for the purchase can be arranged. It is believed that the Local Government Board favourably regard the transfers of such undertakings to municipal authorities, and provisions for the purpose will be found in the Public Health Act, 1875. The transfer of the works and liabilities of the company, which extend into many of the suburban districts, might require special legislation; but on this point, as well as on the previous question, your committee offer no opinion. It is necessary to add that this suggestion is not made with the consent or knowledge of the directors of the water-works company."

Alderman JONES said the proposition as to the city acquiring the undertaking of the water-works company he considered a very important matter, and he took upon himself the responsibility of bringing it before the council, and asking whether or not the city should have the control of its own water supply. This not only concerned the question of quenching fires, but it had reference—it might be—to the saving of life and a large extent of property, while the whole of their sanitary arrangements and the health of the city depended upon the efficient working of the water supply. As they would see by the report, it was stated that the Local Government Board favoured the idea of towns obtaining possession of their own water supply, and he had in his hands a list of 110 towns which now had control of their water supply. In that list there were 19 towns, chiefly very large ones, which had only lately obtained control of such works. Amongst these were the big towns of Birmingham, Birkenhead, Bolton, Bradford in Yorkshire, Brighton, Chester, Glasgow, Leeds, Liverpool, Manchester, Oldham, and Rochdale. These were large towns whose inhabitants well knew what their interest was. It had been argued, he knew, that the management of such a concern as that could not be well undertaken by the council. But he must demur to that argument. He did not think gentlemen would be inclined to admit that they were not as capable of conducting such an undertaking as the inhabitants of those large northern towns. He took it that they would not do so much discredit to themselves. He believed they could manage the work properly, and he should like to see them doing so. There was no disguising the fact that the amount involved was a large one, but the longer the matter was delayed, the greater the amount would be. He thought a large population like that should not fear to undertake such an outlay. Reminding them of what they had accomplished with the docks, and how those docks had increased since they came into the possession of the city, after an arduous fight twenty-eight years ago, he said he had not one word to say in disparagement of the management of the water-works company. He believed that, upon the whole, the works had been managed extremely well, and that Bristol was very much beholden to the company for having established the water-works. They took the initiative; they had had a long and arduous and very uphill fight, and they had at last achieved a great success, as was shown by the large dividends they had lately given their shareholders, and by the value of the shares at the present time in the market. They had done so much for Bristol that he thought they were entitled to be treated most liberally, as Bristol would never have attained the position it had reached if it had not had a water supply well worked as it had been by the present company, while modern Clifton could not have come into existence at all. Many of them would remember how old Clifton—or a large part of old Clifton—used to be supplied with water. It used to be hawked about from springs there, and was sold at so much the bucketful. But a different state of things prevailed now, and he thought they ought to feel extremely obliged to the water-works company for accomplishing what they had with reference to the water supply. He argued that so lucrative an undertaking as that would well be in the hands of the city. It must necessarily be a very increasingly lucrative business, and the longer they allowed its purchase to be delayed, the more they would have to pay for it, and the longer they would be deprived of the advantages they would have in its possession. The profits would necessarily be very large, and they would be devoted either to the reduction of the water-rate or to the borough-rate. In either case the city would have all the advantage, and he submitted that it was most desirable that the question should at once be entertained. He moved—"That the council is of opinion that it

will be for the interest of the city to acquire the undertaking of the Bristol Water-Works Company, providing the purchase can be effected upon equitable terms."

Alderman BAKER seconded the resolution. If it were a proposition to purchase the undertaking of the water-works company *coûte que coûte*, they, of course, would not be right in undertaking such a resonsibility; but as the resolution bound them only to negotiate with the company, to ascertain the facts of the case, and to see whether advantageous terms could be arranged, he thought they certainly could not be wrong in going so far as that. He was not at all sure that corporations could manage such undertakings so well as could individuals who had a direct interest in them; and he was also aware that the labours already imposed upon the council were heavy; yet, if it could be shown that the step was an advantageous one, he did not think they should shrink from undertaking the management of that very large concern, especially if they could see that, by doing so, they would be confering a substantial benefit upon their fellow-citizens. No doubt, if the city were to remain in its present condition, and if they were merely to purchase this concern, and take it over in its present state, and there was to be no development of it in the future, there would be very little advantage in it; but the advantage that would accrue to the corporation was that, in the future, Bristol would increase and largely develop, and, consequently, the revenue of the water-works would relatively increase, and the profits of that development and increase would go into the pockets of the citizens, directly or indirectly, intead of into the pockets of the shareholders of the company. Of course, they would have to inquire very closely into the condition of the undertaking before the negotiations went far. At present they knew nothing of the condition of the works, or whether the supply of water was adequate for future wants. Should the committee, to be appointed that day, find that the result of their inquiries was satisfactory, and that the works could be acquired upon reasonable terms, the city would do well to purchase the undertaking.

Mr. W. P. KING observed that it had been stated that the water-works undertaking was much more likely to be well managed in the hands of a private company than in the hands of the corporation; but he could hardly agree with that feeling, even if it they were an entirely free company; but it was not so, for, above a certain amount, he believed 10 per cent., the company could not pay any dividend, and they had at present arrived at the happy state when they distributed the utmost amount of dividend which they were allowed by Act of Parliament to distribute. He pointed out, too, that the officers of the company had no pecuniary interest in seeking to reduce their expenditure so that a larger revenue might accrue, as the dividend which they were enabled to pay was restricted.

Mr. W. PETHICK said the dealings of the water-works company with the city of Bristol had been spoken of in eulogistic terms, but whilst he did not wish to underrate the manifold and manifest advantages which the city had derived from the water company, he could not conceal from himself that the undertaking had been managed in a way which no corporation would manage it for the public interest. With the utmost respect for the board of directors of the water company, he could not help feeling that their treatment of the citizens had not been so liberal as to entitle them to much consideration at the hands of the council. The water company had acquired powers which were deeply to be regretted, and he thought that if the council had ever seen, to the full extent, what they were doing when they acquiesced in those powers, they would have carried their opposition to the granting of them to a very much greater degree than they did. Having obtained those powers, the company were now in a position to make cumulative charges, and there was abroad a very strong feeling that they had pressed the citizens almost to the limits of forbearance. The property had become very valuable under legislation which he characterized as altogether unfair in the interests of the city. Now that they were being attacked by a new company, when they had carried their company to the highest possible pitch of pecuniary revenue, and were paying 10 per cent., and threatening to pay back dividends, and remembering the treatment the citizens had received at their hands, he thought the time inopportune for making such a proposal. The company not only made the citizens pay for water which they had had, but they also made them pay for water when they could not supply it, and enforced all their rates. He hoped that there might be found in Bristol sufficient public spirit to bring about a competition with those gentlemen, for whilst he felt that citizens should pay a fair price for benefits conferred, at the same time he thought that they had been very hardly used by the company.

Mr. C. J. THOMAS observed that very shortly after the establishment of a water-works company was proposed, the question came up in the council whether or not they should support the establishment of such a company, and it was suggested that it would be far better that the corporation should become the owners of their own water-works. Some gentlemen, very esteemed friends of his—men who were reckoned as the longest-headed men in the council—scouted the idea, and said it would never pay. At that time, down in the lower part of the city, along the level of the river, there was not such a thing as a drop of pure water to be had, and therefore a very great boon was conferred upon the city by the establishment of the company. For ten years after he went upon the board he never received a single farthing of interest for money invested, nor a farthing for his exertions as director of the company, and he held in his hand a return of how the company paid for the next ten years. The first dividend was paid in 1856, and was 3s. 6d. on a £25 per share; in 1857 it was 4s.; 1858, 5s. 6d.; 1859, 7s.; 1860, 9s. 6d.; 1861, 11s. 6d.; 1862, 13s.; 1863, 15s. 6d.; 1864, 18s. Mr. Pethick scolded the company for taking money for that which the city did not get, but their expenses for obtaining water were going on all the time, and the rate was one which the citizens were liable to pay in advance. He thought they were not open to the heavy charges which Mr. Pethick had brought against them. His friend Mr. Wetherman, and himself, being directors of the company, would not vote either way on the question before the council; and he might say, on behalf of the company, that any proposition made to them would be dispassionately and fairly considered. The water company had, since they obtained their additional powers, trebled the supply to the city, and were now making a very heavy outlay to provide against any accident to the mains, by which the supply was brought into the city, by laying down another set of pipes, so that the supply should not be broken. If the corporation purchased the interests of the water company, he certainly did hope it would be for the advantage of the city in the future.

Mr. B. G. BURROUGHS thought the present time was particularly inopportune to attempt to negotiate with the water company. The city had in prospect the blessing of competition, and they did not know what advantage that might be.

Mr. MILLS objected to the motion as it stood, because it would bring them before the company as eager buyers of their undertaking, but he would vote for the appointment of a committee to consider the expediency of purchasing.

Mr. NASH thought the fact of another scheme for supplying the city with water having been introduced, made the present a favourable time to look into the question without delay. It might be that it would be found to be desirable that they should have one company to supply the eastern, and the other the western portions of the city; and another question was whether it would be desirable to have the streets torn up by two companies.

Mr. E. S. ROBINSON observed that there were a number of advantages which the city would gain if it possessed the water-works. The question came up naturally and necessarily upon the consideration of the question of the fire brigade, and they could all see what an advantage it would be that the city should be enabled to make more effective arrangements for extinguishing fires. They were constantly seeing that as soon as a macadamized street was laid down, it was torn up by the water company. That was owing to the divided authority, and it was essential in the interests of civilization that they should have their streets under one authority. Having adverted to the advantage upon sanitary grounds of an adequate supply of pure water, he said a Royal Commission in 1869 reported that the public health would be very much better kept, and sanitary arrangements much better enforced, if water-works were put under the control of municipal authorities. At Birmingham in 1851 the water company were willing to sell their works to the town for £250,000. The occasion, however, was lost, but the subject came up again in 1864, when the company were willing to sell for £400,000. Those negotiations, however, resulted in nothing, and in 1875 the Corporation of Birmingham did purchase the water-works at an expense of one million. The value of the water-works property had increased £600,000 in ten yesrs. He did not say that the water company had been as liberal as they ought to have been, but ever since they obtained their last bill, the city had had a constant supply of water. He approved of the water-works being acquired by the city if they could be obtained upon equitable terms, but those who projected the company got nothing for their outlay, nor for their attendance to its affairs, and the council must be prepared to pay a liberal price.

Mr. FOLLWELL said the matter had been before the council more or less for the last 20 years, and unfortunately it had come up now just at a time when another company was proposed to be established. If the corporation purchased the water company, the council would have to fight the battle with the new company in opposing the bill that they were promoting in the coming session of Parliament. If the existing company had to oppose the new company, and the latter obtained their bill, then the council would be in the position of having two companies to treat with. He thought it unwise for the corporation, at the present time, to have anything to do with it, but to let the water company fight their own battles.

On a division the motion was carried by 34 to 6, and a committee was appointed to negotiate with the water-works company.

A TALE OF THE NEW RIVER COMPANY.

As the citizen of London passes along Islington Green, he will see a monument to Sir Hugh Myddelton, a London citizen, whose name should be held in everlasting remembrance. It is to be questioned whether London ever had a worthier son. He was a Welshman—that, of course, he could not help—born in the year 1555. It was to his credit that he came to London, and made money as a goldsmith. It is still more to his credit that, with a view to benefit himself and his fellow-citizens, in 1606 he agreed to supply London with water from streams of the pure element in Middlesex and Hertfordshire. In 1608 he commenced the undertaking, which was considered formidable, if not impossible. Never had man born of woman a harder work. It is wonderful how he could have kept up through it all. On all sides he had opposition to encounter. On all sides difficulties were heaped in his path. Such a thing was a novelty and innovation such as John Bull had never seen before. Was not there the Thames, and what could be easier than to get water thence? If the Thames was too far, were there not Clarke Well, and Clement's Well, and Holy Well, always supplied with excellent water, and quite at one's very door? Possibly, at that time there were those who did not disdain the waters of the Fleet as they flowed from Hampstead amongst green fields and ancient woods right down to the City Gate of Lud. Mr. Myddelton, it was thought by many, had better have kept to his goldsmith's shop, which must have been a good one then, and not troubled himself with matters above him. Happily, Mr. Myddelton did not think so. He was a public-spirited man. He did not consider that a shopkeeper or a merchant comes into the city merely to make what he can in it. He thought he had duties to discharge to the City, in which he had spent his life and made his fortune, and he laboured at his self-assumed task in spite of the opposition of the landowners along the line to the new canal—in spite of the indifference and cold support of the public—in spite of that sad calamity the failure of his funds. Happily, he did not labour in vain. Happily his sanguine hopes were justified. Happily, in 1613, the work was satisfactorily completed, and the water was let into the reservoir at Islington. By the time it was done, the public had become quite aware of the real importance of the work, and Stowe gives a quaint account of the rejoicing on the occasion. London turned out in all bravery to do honour to the event. First and foremost of the company was the Lord Mayor with all his attendant suite. Besides these were sheriffs and aldermen and common councilmen, and the citizens completed the company. It is to be presumed the ladies were present, but old Stowe says nothing about them, and the art of graphic reporting had not been invented at that time. If they were not there, they ought to have been, for where does woman shine to such advantage as when she presides at the tea-table, and gracefully dispenses to her friends the cup that, as it has often been said, but never said too often, cheers but not inebriates? And where, it may be asked, would our fair tea-makers have been, had it not been for the New River water? Stowe tells us instead of "the labourers well aparaled," to the number of sixty or more, carrying the instruments of their labour, who presented themselves before the magnates of the corporation, while one of them delivered, on behalf of the rest, a speech in verse, intimating that long had they—

> "Labour'd, long desired, and pray'd
> For this great work's perfection, and by the aid
> Of Heaven and good men's wishes 'tis at length
> Happily conquer'd by cost, art, and strength."

And honouring the brave originator as only aiming at the City's good, and referring to the timely aid of royalty, that of King James I., who shortly after had a narrow escape of drowning in the canal he had assisted to form—all at once there was a change in the poetry, and the reciter turned away from the company, as he exclaimed:

> "Flow forth, precious spring,
> So long and dearly sought for; and now bring
> Comfort to all that love thee; loudly sing,
> And with thy crystal murmurs shock together
> Bid all thy true *well*-wishers welcome hither."

And at this summons, though the rhyme was bad, and the pun was worse, the flood-gates flew open, the stream began to flow, the drums beat, the trumpets blew, the bells rang, and London's greatest want was supplied—a pure supply of the first necessary of life. Mr. Hugh Myddelton became a baronet, and never was the honour more worthily conferred or more honourably won. Yet even in honouring Sir Hugh Myddelton's public spirit and patient enterprise, we must not forget that after all he was but the right man in the right place. The idea he originated was not entirely a novelty. The Corporation of London had indeed before him felt the need of making an adequate supply of water for the citizens of London, and had gone so far in the reign of Queen Elizabeth as to obtain an Act

to enable them to cut a river to bring it to the City from any part of Middlesex or Hertfordshire. Already they had a dim perception of the truth that cleanliness was next to godliness, and that the health of the Metropolis depended upon the use of pure water, that luxury and necessity of life. In these days when we have become used to the wonders of engineering skill; when we talk of tunnelling under the Straits of Dover; when we are promised salt-water baths from Brighton at the Crystal Palace; when people talk of emptying Loch Katrine into our London reservoirs, as if Scotland was but a mile or so from town, Sir Hugh Myddelton's performance does not seem such a wonderful performance. And when we rush down by the Great Eastern Railway to Hertford, or take our summer walks abroad among the roses of Cheshunt or the hayfields of Enfield, the New River, as it sweeps along past pretty villas and trim gardens, seems as much a matter of course as the Lea itself. But in Myddelton's day it was a wonder and a triumph of engineering skill, such as England had never seen. The distance from London to Ware, as the crow flies, is about 20 miles, but Sir Hugh Myddelton's river had to wind about till it was nearly twice that length, and the expense was enormous, although labour and the materials of construction cost much less than they do now. The worthy goldsmith's capital was exhausted when he had expended about £4485. The situation was an unpleasant one. If the work stopped all that money would be wasted, and he would be a beggar. In our time the matter would have been easily arranged. We should have had a limited company formed, with an M.P. or two on the direction. *The Times* and the *Daily News* and the *Standard* would possibly have recommended the scheme, and the organs of teetotalism and the United Kingdom Alliance would have been jubilant in its praise, and the money would have been raised at once. In that day joint-stock enterprise was unknown, nor had the press yet become a power. Under these circumstances Royalty was appealed to. In our young days James I. was held to be the British Solomon; in his own time he was told to his face by his clerical flatterers that he spoke by the inspiration of God. The world does not think so highly of him now. Be that as it may, in responding to the appeal of Mr. Myddelton, King James did one of the most sensible things he ever did in his life. For the aid he rendered the work Myddelton conveyed to him one-half. Never was money better laid out or more judiciously expended. The cost of the entire undertaking appears to have been £17,000. Of this sum his majesty advanced half, and the expended capital was divided into several shares, of which half belonged to the king, and half to Myddelton. Sir Hugh parted with most of his shares at a good profit. Twenty-eight were thus placed, and lucky indeed were they who held them. It was they who formed the governors and company of the New River, brought from Amwell and Chadwell to London, formed in 1619. At first the undertaking was by no means a financial success. For 20 years the company divided no dividend, all the receipts being devoted to improving the property and developing the resources. Even after it had begun paying a dividend it had to encounter evil times, and in 1636, when King Charles I. was hard up, as even monarchs sometimes are, and when there was a talk of making a further call upon the shareholders, he parted with his shares for a guaranteed rental of £500 per year. After this the property gradually improved, and now each share yields a dividend of no less than £2000 per year. It also confers the right to the franchise in the counties of Middlesex and Hertford; and in 1711 Lord Chancellor Cowper decreed that the possessors of two or more fractional parts of an Adventurer's share, being equal to one whole Adventurer's share, might depute a person to represent them in the government of the company. It may be remarked that, under the arrangement made with the king, his majesty had nothing to do with the government of the concern.

But we have not yet described the New River. At its first formation it was 18 feet wide and 5 deep, and had a fall of about 5 feet a mile. The water is stored in reservoirs at Cheshunt, Stoke Newington, and Clerkenwell, having an area of 43½ acres. Into the reservoirs at Claremont Square, Maiden Lane, Highgate, and Hampstead, 20 millions of gallons of water are pumped up by a pumping power of 1700 horses, and thence it flows along—incredible as it may seem—620 miles of mains. In 1869 it supplied 800,000 inhabitants, living in 113,462 houses, with 23,796,667 gallons. It has now, at least, some nine rival companies in the field. Between them they supply the four millions of inhabitants of London with 35 million gallons of pure water; but the New River Company still maintain their proud pre-eminence, and calculates that, with their present powers, and with but a little extra effort in the way of engineering, they could supply as much as 35 million gallons to London's thirsty souls. Evidently, then, the company cannot be said to overtax its powers, or to have arrived at the condition when, commercially, it has ceased to be a profitable investment. It has naturally all the north of London for its own, and it is in that quarter—or rather in the suburbs bordering on it—that the rapid increase of population is most marked, and that "genteel semi-detached villas," as the advertisers term them, are most in request.

A few figures as to the value of the shares cannot fail to interest the curious reader. It is rare indeed that an original share is in the market, but during the last few years some fractions of shares have been sold by auction. The values at different times of entire shares, at the rate of which these parts were sold, are as follows—viz., In 1814, £7450; 1822, £9450; 1858, £9800; 1870, £42,360; 1873, £48,960; 1876 (February), £64,000; 1876 (July), £88,050; 1876 (November), £94,050. The shares issued in 1866 have also realized large prices at auction. The last quotation for the £100 paid up shares (which was about six months ago) was £320, and at the same time some £100 shares, with £70 paid, were sold at £280. Since then the latter have been sold at £310, which is their last and highest quotation. One-thirtieth of a "King's Share" was recently sold for £3135.

The following official statement shows the marvellous and steady increase in the receipts of the company for water supplied during the last 15 years:—1861, £189,732 12s. 4d.; 1862, £194,169 6s. 11d.; 1863, £204,750 1s. 7d.; 1864, £218,709 10s. 10d.; 1865, £225,013 4s. 8d.; 1866, £232,606 15s. 7d.; 1867, £240,934 2s. 11d.; 1868, £244,940 14s. 1d.; 1870, £258,684 3s.; 1871, £268,717 3s. 7d.; 1872, £281,434 19s. 1d.; 1873, £292,388 5s. 3d.; 1874, £308,550 6s. 9d.; 1875, 329,073 0s. 1d. Market value of King's shares, 1814 to 1876:—1814, £7450; 1822, £9450; 1858, £9800; 1870, £42,360; 1873, £49,000; 1876 (June), £64,000; 1876 (July), £89,090; 1876 (November), £95,100.

As to the future of the New River Company there is every reason to be sanguine. It has not exhausted its mission. It has not had its day. Water is more and more in demand, and water London must have, till Macaulay's celebrated New Zealander, standing on the broken arches of Westminster Bridge or Blackfriars, shall contemplate the ivied ruins of St. Paul's. Till that time the shares of the New River Company may be expected to command an increasingly high price in the market, as its income is not only derived from water-rates and water sold in bulk, but from its extensive private estates in and around London, which become more valuable as leases fall in. Altogether it is a marvellous history that of the New River Company. Of this let us give one further illustration. The King's shares parted with by Charles I. for so trifling an annuity as £500, are now valued each at £94,000. Royalty made then a very bad bargain for itself. But as others have reaped the benefit, there is not so much cause for regret after all.—*City Press.*

GAS SUPPLY FROM WORKS WITHOUT A GASHOLDER.

By M. Servier.

[Paper read at the last Annual Meeting of the *Société Technique de l'Industrie du Gaz en France.*]

The object of the communication I am about to make to the Society is to demonstrate the possibility of gas-works performing their functions without the aid of a gasholder. It is evident that here the question is not one of a normal supply, and though I made the experiment with it, I beg you to believe that it was not for my personal amusement. First of all, then, I will state the causes which led me to make this experiment, which was attended with perfectly successful results.

The contract for lighting the town of Metz has been but lately renewed, and the considerable reduction in price which has resulted therefrom—a reduction from 45 to 27 centimes per cubic mètre (about 10s. to 6s. per 1000 feet), upon which the town authorities impose a further tax of 5 centimes, making the net price 22 centimes—has prcportionately developed the consumption of gas. It has also compelled us to seek for more economical modes of manufacture.

The old gas-works at Metz, constructed at a time when the railway was not in existence, were erected on the road from Metz to Saarbruck, where the coal mines are situated; but the railway terminus was built at the other end of the town, about three miles from the gas-works. The first piece of economy to be practised in the development of the manufacture was, therefore, to move nearer to the railway terminus, and this we did by erecting a second gas station close to the line. This station was destined subsequently to replace the original works. These new works are furnished with larger retort-ovens, and so arranged as to manufacture gas more economically.

I was pledged to light the railway offices, &c., in the month of October, 1875; but, in consequence of delays, I was unable to complete the gasholder in time to be of service. Then came the frost, and, briefly, I found that the gasholder could not be brought into use till the spring. However, I wished to fulfil my engagements, and add to the receipts the amount which the lighting of the railway offices would have brought us.

It was under these circumstances that I decided on starting the works without a gasholder, and I am about to point out to you the precautions to be taken in a similar case, and to explain how, although I got very well out of the difficulty, I might have done still better than I did, had I thought sooner of another solution, which I have just applied with a different object.

I ought at once to say that the existence of the old works, with the gasholders, facilitated the service I wished to effect, by reason of the connexion existing between the two stations through the network of mains; but it will be seen that this condition is not necessary.

The day supply, as well as that which is furnished after midnight, is very regular in the majority of towns; that is to say, the hourly consumption is pretty nearly equal. This consumption being known, it is sufficient to charge the retorts with the quantity of coal absolutely necessary for the production of the amount of gas desired, sending the gas direct into the town. This is what was done during the day, and after midnight. With regard to the evening, the retorts were fully charged, and the two works being connected by the mains, I was able, by means of the governor, so to regulate the supply from the works provided with a gasholder as to leave the works unprovided with one to send out all the gas they produced. In this way the pressure on the retorts and other apparatus did not exceed the proper limits, which would not have been the case if the works without the holder had produced more gas than they were able to send out.

But this regulation of the charges during the day and night, and of the pressures during the evening, is not the only precaution to be taken in a service of this nature. You know, in fact, that the coal does not produce, during the different periods of its distillation, a uniform quantity of gas, or gas having a uniform illuminating power. The first portions of the gas produced, like those which are given off last, have a much more feeble illuminating power than the gas produced in the middle of the distillation. To remedy this serious inconvenience, the retort charges were fractionated as much as possible—that is to say, every hour a fourth of the retorts were charged, in order to obtan a gas of an average illuminating power. We even noticed that, notwithstanding this precaution, it was necessary to add a small quantity of Boghead or cannel to each charge, to improve the gas produced at the commencement of the distillation.

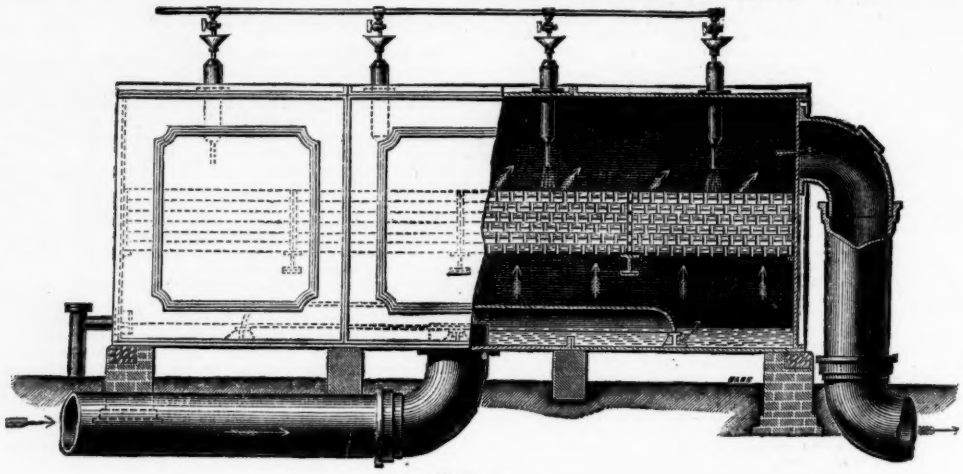
It is equally necessary, during the lighting hours, to refrain from putting into use purifiers that have just been renewed, and contain air, which acts injuriously on the illuminating power of the gas, unless the precaution be taken to expel the air by means of valves in the covers.

The same supply could be afforded by a single work which, from any circumstance whatsoever, had been deprived of its gasholder; but it would be necessary to take a fresh precaution, which would be, before sending the gas into the town, to cause it to pass through a small bell-shaped vessel suspended in water, and weighted to the maximum pressure which it was desired that the apparatus on the works should bear. This vessel would be furnished with an outlet-pipe, which would allow the gas to escape whenever the proper pressure should be exceeded. The gas so escaping might go to waste, or, better still, be conveyed into the retort-oven, and there utilized for keeping up the heat. I should add that in one case as in the other it is indispensable to entrust the service to intelligent and conscientious foremen.

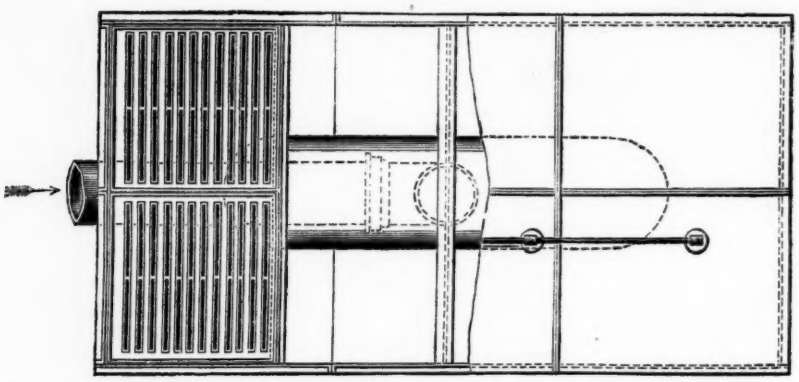
I have already said that I could have done still better if I had thought in time. This is what I am now actually doing, although the gasholder is in use, but with a different object, which I am about to indicate to you. I have remarked that the new works were capable of manufacturing gas at a lower rate than the old, consequent upon the economy effected in the transport of the coal and the employment of improved apparatus. But beyond this the old works possess extensive gasholders and large outlet-pipes. These I was desirous of utilizing, while making the gas exclusively in the new works, at least during a great portion of the year. For this purpose I connected one of the outlet-pipes at the old works, in front of the outlet-valve, with the inlet to the exhauster. In this way the old works draw off by means of the network of mains, the gas made during the day by the new, store it in the holders, and send it out in the evening through the large outlet-pipes. I can thus draw off 150 cubic mètres (about 5000 cubic feet) per hour without any inconvenience. I do not increase the leakage, as the suction of the exhauster is so regulated that the pressure on the mains is unaltered. There is, however, a slight oscillation produced by the exhauster, which is on Beale's system; but that is of no importance for day consumption, and moreover could be entirely suppressed by using one of Schiéle's or Körting's exhausters, the action of which is much more regular, or by interposing a governor between the main and the exhauster. But I repeat, the oscillation is so slight that it is not even necessary to make this addition.

You see, then, that I could have saved myself the trouble of regulating the retort-charges with so much care on the works unprovided with a gasholder, by drawing off, as I now do, the gas produced there, and storing it in the holders on the second works. But we do not always think of everything, and thus an opportunity was afforded me of making an experiment which perhaps may be of some use in exceptional cases.

SAVILLE'S PATENT GAS SCRUBBER-WASHER.



ELEVATION.



PLAN.

The simplicity and efficiency of apparatus employed for the purification of gas is a paramount problem in its manufacture. Every manager of a gas-work, especially in the "full make" season, when all his apparatus is taxed up to its greatest capacity, is as anxious for the quality as he is for the quantity of the gas produced, being fully aware that public observation and the "inspector's report" deal mainly with the former of these considerations. It is comparatively easy to increase the quantity when a brisk demand occurs, such as is usually experienced in mid-winter, by "driving" the retorts; but in proportion as this is done, the whole purifying plant (especially where lime or oxide is the only means of purification employed), becomes a source of increased anxiety, labour, and cost, and, in most neighbourhoods, a most frequent nuisance. Although lime and oxide have been the prolific means employed for this purpose, it has long been felt that much greater economy may be effected, and much abatement of the nuisance of changing large open boxes charged with "loud odours" may be attained, by the extended use of water, either in washers where the gas is caused to pass through water, or in scrubbers where a large area of damp surface is obtained by the mechanical distribution of a minimum quantity of water, so that the gas, passing over such surface, may precipitate more or less of its impurities.

At the meeting of the British Association of Gas Managers, held in the rooms of the Society of Arts last June, the President (Robert Morton, Esq.), in delivering his Inaugural Address, made the following remarks in reference to "New Inventions":—"Of these there have been about the usual number relating to the manufacture, purification, measuring, carburetting, regulating, distributing, testing, and burning of gas, and I think fully the ordinary proportion will not get further than the 'provisional protection' stage.

"There are, however, some which are really valuable; time will only permit of my mentioning one or two. A 'Washer,' by Mr. G. E. Saville, of Sowerby Bridge, a diagram of which is exhibited on the wall, and by which the gas is brought into very intimate contact with the water, and that without much increase of pressure. A vessel, 8 feet square, with the working part only 20 inches high, gives 1600 lineal feet of dip, 830 superficial feet of wetted surface, and 250 square feet of water area, throwing about 1½-inch pressure. I am told that gas free from ammonia, and containing comparatively little CO_2, is obtained by its use, while the water used escapes as very strong liquor, 20-ounce to 30-ounce."

At the same meeting, Mr. Charles Hunt, of Birmingham, read a paper on "Washers or Scrubbers," in which the following statement appears:—"So far as I am aware, washers have not, hitherto, been employed to any extent for the final process of removing the last traces of ammonia, although there seems to be no reason why they should not, and a few weeks ago I had an opportunity of inspecting a new form of washer, designed by Mr. Saville, of Sowerby Bridge, alluded to by the President in his opening address, which has proved efficient for this purpose."

The results of analyses give a high duty, although taken from the first of Mr. Saville's washers, fitted with wooden troughs for experimental purposes, passing half a million feet per day.

The above illustration is a scale representation of a washer 16 feet by 8 feet by only 4 feet high, capable of washing 3 million cubic feet per day. We are informed that the makers are now erecting one at the Corporation Gas-Works at Birmingham, and another at the Phœnix Gas-Works, Vauxhall, London, of the above capacity. Mr. Saville has arranged with the large and eminent firm of Messrs. Tangye Brothers and Holman for the manufacture and development of his invention, and we find, by a circular issued by the firm, that patents have been secured in Great Britain, France, Belgium, Prussia, Austria, and the United States.

The mechanical arrangement is thus described:—The washer tank contains a large bottom chamber, into which the gas is freely admitted through an ordinary full-way inlet-pipe, passing first under an inverted vessel, to remove any tar remaining in the gas after leaving the condenser; it then rises slowly over the whole surface, containing an area of openings equal to about eight times that of the inlet-pipe, through equidistant spaces and through a series of slightly self-sealing water troughs arranged in tiers, thus dividing itself into 960 streams of gas, each of which is passed through cleaner liquor at each tier as it rises, until it ultimately issues through nearly clean water into the large upper chamber, and from thence through the outlet main-pipe.

The washing liquid, being *clean water*, enters into the tank through the syphon inlets on the top, each having a regulating-cock to equalize the supply to each square of troughs, and these are controlled by one main cock, so that the quantity of water admitted may be exactly proportioned to the quantity of gas to be cleansed and the strength of ammoniacal liquor desired. The thorough cleansing of the gas is thus effected by simple water gravitation, and dispenses with all machinery for distributing the water or repumping the liquor, the latter being brought up to any required strength by once passing through.

It will be observed that in this admirable "scrubber-washer" the gas comes first in contact with the "*strongest* liquor" at the bottom, and is all washed six times over in one vessel, passing through weaker and cleaner liquor at each successive tier as it rises, until it issues through nearly "*clean water*" into the upper chambers. Moreover, the same gas never touches liquor of the same strength more than once, and as it issues through the last tier of troughs it meets constantly in-running streams of clean water. Thus, the true principle of the automatic purification of gas by a very simple process of *washing* appears to be very effectually and economically wrought out.

STOKE, FENTON, AND LONGTON GAS COMPANY.—The annual general meeting of the shareholders was held on Thursday last, Mr. C. M. Campbell, M.P., chairman of the board of directors, presiding. Mr. M'Millan, the secretary, presented a satisfactory report. Very extensive and important alterations have been effected in connexion with the plant, and in development of the works. Many new mains have been laid down, and an order had been given for the mains for laying on gas to Basford. The report was adopted, the usual dividend of 10 per cent. declared, and the routine business transacted.

DARLINGTON CORPORATION GAS SUPPLY.—At the annual meeting of the Darlington Town Council, on Thursday last, an animated discussion, introduced by the Mayor (Mr. Plews), took place with reference to the deficiency of street lighting, and the general lack of illuminating power about the gas. The Mayor said that the gas was not equal to that of other towns, and parties had told him that they had done away with it and used lamps and candles, a remark which Mr. Morrell confirmed in his own case. It was stated that the burners had been reduced in size for the street lamps. Mr. Foggitt said that the engineer had stated that there was a sufficient quantity of light throughout the town, and that the public lamps burned 5 feet of gas per hour. Mr. Pease thought it was rather a sharp trick if the burners had been reduced in size. Two or three gentlemen favoured the engagement of a public analyst to report upon the quality of the gas. Alderman H. Pease confirmed the testimony given as to the deficiency of the light from the public lamps. He hoped that any defect in the quality of the gas was not, as had been said, owing to a deficiency in or a smaller supply of cannel coal. The subject was referred to the Gas and Lighting Committee. The report of the gas manager was read, showing an increase in the consumption of gas last year of 1,725,600 feet.

ENTERTAINMENT TO EMPLOYES AND THEIR FAMILIES AT THE CORNWALL WORKS, SOHO, BIRMINGHAM.

The rapid rise and growth of the great engineering establishment known as the Cornwall Works, and their continued prosperity during a period of national depression, are due, perhaps, quite as much to the broad and enlightened policy of Messrs. Tangye Brothers in regard to their workpeople as to their commercial enterprise, and the application to the trade of the most approved appliances and machinery. The conduct of extensive works like these—where nearly 1500 hands are employed—requires tact and judgment of no ordinary kind; and the fact that since the establishment of the firm 18 years ago, there has been no breach in the cordial relations subsisting between the firm and their men is an incontestable proof of the prudence and foresight of the employers. Messrs. Tangye are both advocates of temperance, and are themselves total abstainers; but while they endeavour, by the force of example, to encourage temperate habits among their artizans, they do not resort to coercion. The results are, therefore, the most permanent, and strict sobriety is the rule among their numerous *employés*. Understanding the importance of education, and particularly of technical education, to men employed in a skilled industry, the firm years ago commenced a night school at their works, in which not only rudimentary instruction was imparted, but in process of time the pupils were taught machine construction and drawing, mathematics, &c. As an incentive to the men towards punctuality and industry, the firm have recently decided upon awarding silver medals to those who have complied with these requirements, and have been in their employ 15 years. Already six of the hands have obtained these emblems of meritorious services, which cannot fail to be useful to them in after-life—helping them, in fact, to acquire better situations. The principle on which Messrs. Tangye have acted in this respect has been that, inasmuch as soldiers are rewarded with medals for services in warlike occupations, they thought there was even greater reason that men employed in peaceful avocations should receive similar decorations. Further, the firm have received medals from various industrial exhibitions of the world, which they highly value, and deem that their workpeople would equally treasure like tokens of appreciation. Five more medals were presented at the annual tea party given by the firm to their workmen and their wives and children on the 27th ult. Between 3000 and 4000 persons are entertained every year in this convivial manner by Messrs. Tangye, who personally enter into the proceedings with a great amount of interest. The large dining-room, in which the festive gathering was held, was handsomely decorated, and several Christmas trees were displayed, bearing an ample supply of toys and sweetmeats for distribution among the children. A striking illustration of the manner in which Messrs. Tangye retain their *employés* is shown in the circumstance, that of the 25 men who were in their service in 1858, no fewer than 20 are still remaining, and the aggregate number of years service rendered by the six who had previously secured medals was 105 years. In the course of an address to his workpeople last week, Mr. Richard Tangye, who has only recently returned from a tour round the world for the restoration of his health, remarked that it was a source of great satisfaction to himself and brother to be able to meet their operatives in that free and unconstrained manner, and to express their cordial interest in their individual and collective welfare. The conduct of so large a business as was carried on at those works was in itself sufficiently arduous, and full of care and anxiety, but if to these were added—what was customary among other firms—difficulties and misunderstandings with their workpeople, their task would be almost impossible. Fortunately they had always been free from such difficulties. It was the bounden duty of employer and employed to do all in their power to make their mutual relations as comfortable as possible. He was sometimes asked by manufacturers, how it was that the firm of Tangye Brothers managed to get on so well with their men, and his reply was in the words of a Quaker, that had been impressed on his mind at the time when they started business—"If you want to know how to manage your men, study human nature." Human nature was the same in the master as in the man, and what it demanded was, that a man should be treated as a man, fairly, honestly, and squarely. If a master could only succeed in convincing those with whom he had to do that such was his desire, he would have very little difficulty in dealing with them. Mr. Tangye then referred to the attempt now being made in the engineering and other trades to restore the ten hours system of working. Some of the masters attributed the present depression in trade to the introduction of the nine hours system. Two years ago, it was represented that the firm of Tangye Brothers were about to give their men an entertainment, and take the nine hours from them, but the firm had never contemplated such a contingency. In the iron trade, some of the masters thought a return to the ten hours system would lead to an improved trade, but he had never hesitated on the question of giving the nine hours; and since it had been adopted at the Cornwall Works, it had been an unqualified success, and had not failed in a single particular. The firm, instead of losing thereby, had gained pecuniarily, and they felt they had also gained the respect and good-will of their operatives, which in itself was a source of great gratification. They had given the nine hours voluntarily, having led the way in that direction, and consequently they had no old scores to rub off after they got into good working order under the new system. As was well known, the contrary was the experience of the majority of other masters. They wanted to have the concession forced upon them, which accounted in a great measure for their want of success. If he were allowed to give a word of advice, he should say the sooner they forgot old scores and set about doing the best they could under the new system, which they would never be able to reverse, the better it would be for all concerned, for he was convinced that to reverse the nine hours arrangement would be as difficult a task as that of Mrs. Partington sweeping back the Atlantic. He would not return to the old system under any consideration, and at the present moment—when 19 engineers out of 20 throughout the country were shorter of work than they had been for 20 years—the engineers in the employ of that firm had never been more fully occupied, and never had a slack day. The firm had always employed its full complement of men. From the system adopted there, when the firm made suggestions in the method of working in order to reduce cost, they were not met with suspicion, because the men knew that they did not wish them to earn less, but that they wished to show them how to cheapen production, and so enable them to offer their goods at such rates as would satisfy customers, and thus keep the men fully employed. The remarks of Mr. Tangye were frequently applauded.

At the conclusion of the address, Mr. J. HUGHES, the oldest man in the employ of the firm, proposed a vote of thanks to Messrs. Tangye Brothers for their kindness and hospitality.

The proposition was seconded by Mr. TEAGUE, second oldest hand, and carried amidst tremendous cheering and musical honours.

Mr. TANGYE acknowledged the compliment, and then proceeded to distribute the medals for punctuality and good service, and the evening was spent in a most agreeable manner.

On the following day the remainder of the workpeople were entertained at tea—Mr. G. TANGYE presiding—and addresses were delivered by the CHAIRMAN, by Mr. S. HOLMAN, and Dr. LANGFORD. Refreshments were again provided, and the children received their presents, and a miscellaneous entertainment was given. Nearly 4000 persons were entertained on the two days. The arrangements were made and carried out in an admirable way by the committee, and considering the onerous duties devolving upon them, those gentlemen did themselves great credit, and contributed largely to the success of the festival.

A vote of thanks was passed on Wednesday night to the principals in the office, and also the committee of management. On each occasion the proceedings terminated with dancing.

HYDRANTS IN THE CITY OF LONDON.

During the past year the Gas and Water Committee of the Corporation have done much to advance the provision of hydrants at high pressure in the City for extinction of fires and street cleansing, and as the very possibility of any successful action has been denied in many quarters, and doubted everywhere, a short review of what has taken place is not without interest. In their report of July 30, 1874, the committee set forth the great importance of hydrants supplied with water at high pressure for immediate use in case of fire, and they showed so clearly that it was possible to establish these at a cost which, though considerable in amount, was small in comparison with the public good to be done, that the Court of Common Council at once adopted their recommendation, and they were instructed to take steps for the laying in of service-pipes at constant high pressure, and the erecting of hydrants in streets about to be repaved, at a first cost of £1000. On April 15, 1875, they presented a further report, recommending 36 streets or places in which the pipes might be laid and 64 hydrants erected. This was approved, and the pipes were laid in accordingly; and the Commissioners of Sewers, recognizing the value of such a water supply for the cleansing of some of the street pavements, agreed to contribute towards the cost of the hydrants to be used by them for that purpose. Again, in April, 1876, the committee presented a further report, seeking to obtain the sanction of the court for a further expenditure of £2800. in utilizing forthwith all the pipes which had been laid in, by obtaining designs for the most improved form of hydrant, and erecting the same without further delay. This report was also adopted, and the committee at once advertised for designs, and having received a number, gave the whole a very careful consideration, assisted by the engineer of the Commissioners of Sewers. Finally they made a selection of four, and, having suggested several further improvements—especially that there should be means to fix the hose to each hydrant, so as to obtain a double effect—a trial was held in presence of the committee on the 29th of November last, which was entirely satisfactory as regards the pressure in the service-pipes and the height to which two jets of water could be thrown simultaneously from the same hydrant. This was found to range from 65 to 75 feet, as the jets were slightly affected by the wind; but the relative merits of the several hydrants have not yet been determined, and are still under consideration, and probably excellence of workmanship and non-liability to get out of order may decide the question, as there is little difference in other respects. It should be mentioned that Mr. S. Morley, M.P., kindly permitted the committee to use for their experiments a vacant plot of ground belonging to him next the Memorial Hall. In a short time we may expect that the hydrant found most suitable in all points will be selected and forthwith fixed in the several places already prepared for the purpose. The trial above named proved that the jets of water (from an inch nozzle) could be thrown to a height sufficient for effective use in the event of a fire; in fact, to much the same height as at Manchester, where Mr. Tozer, the superintendent of the Fire Brigade, states that since the use of hydrants, by means of which the police or any one near can use the hose at once, there has been but one case of total destruction in three years, and that out of 306 fires in one year, in only eight cases was it found necessary to use the engines to assist. In a word, it is the use of water in the first ten minutes which prevents a fire. Let it have 20 to 25 minutes to establish itself, and not all the brigade power in London may be able to do more than to preserve adjoining property, to say nothing of the saving of life. This, however, is not all. The New River Company have for nearly two years had works in progress which are approaching completion, and which will have the effect of adding about 50 feet of pressure to the service over the greater part of the City. In other words it will enable a jet of over 100 feet in height to be thrown from the hydrants, instead of some 75 feet, as at present. But it may be asked—What becomes of the pressure when water is being drawn off the main for the house supply? In the first place it may be observed that this at present occurs at a time in the morning when fires rarely break out, but a careful note having been taken once every quarter of an hour in the 24 hours, it appears that while the pressure at night, or from five p.m. to six a.m., is four to five pounds per square inch greater than it was on the occasion of the experiment of the 29th of November (which took place between twelve a.m. and one p.m.), it is from six a.m. till nine o'clock a.m., when the house supply is being drawn off, never more than two to three pounds per square inch less. In close thoroughfares, like some of those branching from Cheapside, where fire engines can be placed only with difficulty, and where goods to an enormous value are closely stored, it is hardly possible to over-estimate the great public good done by the corporation in this matter, which, like so many other of their public works, is for the most part paid for out of their own private resources and not from rates. There remains, however, another important purpose which hydrants will answer—viz., the street cleansing. Wherever the truth may lie in various arguments urged for and against different kinds of street pavement, there can be no doubt that a perfectly non-absorbent pavement like compressed asphalte admits of being most thoroughly and effectually cleansed by a jet of water sent through a chisel-shaped nozzle, with power enough to cleanse the surface of that film of dust, which becomes occasionally greasy, and is distressing to horses unless sprinkled with sand, which seems rarely at hand when wanted, and thus may enable the authorities to use a pavement of that sort with satisfaction in all respects, and with a great saving of labour and money for cleansing purposes; in addition, it may afford the means of more frequent street-watering in summer, which in Paris is done three times a day, to the great comfort of the public, and at the same time no doubt preserving the asphalte from the effects of heat, where exposed to the sun's rays.—*City Press.*

BRADFORD CORPORATION WATER SUPPLY.—At the meeting of the Town Council of Bradford this day, the Water-Works Committee of the Corporation will recommend that the salary of Mr. A. R. Binnie, M. Inst. C.E., F.G.S., be raised from £400 to £1000. The intended recommendation is exciting much opposition in the borough.

ALCESTER WATER SUPPLY.—The success of the Abyssinian well is now an established fact. The boring has proceeded to a depth of 60 feet, but no water was found after a depth of six feet till a thin stratum of gypsum was reached at the above depth, when the water rose within one foot of the surface, being also one foot above the level of the roadway and four feet above the level of the wells. Upon the pump being applied on Wednesday the spring was giving 3½ gallons per minute, which increased to 41 on Thursday, equal to a flow of 270 gallons per hour. It is, however, thought desirable to go a few feet deeper, as it is expected more gypsum will be found immediately underneath the strata already pierced, which will give a much greater supply.—*Birmingham Gazette.*

IRON AND COAL TRADES OF SHEFFIELD, SOUTH YORKSHIRE, AND NORTH DERBYSHIRE.

(FROM OUR OWN CORRESPONDENT.)

The general aspect of affairs in the iron trade of the town has not greatly altered since my last communication was penned; but it appears almost certain that matters have taken a turn for the better in many branches, and are more promising than they were in the autumn. The new year has hardly advanced far enough for any very decided improvement to have been effected, yet there are, in several quarters, preparations for an increased output, both of pig and manufactured iron. The blast-furnace owners are getting a few additional furnaces ready for relighting, the present firmness of the pig-iron market leading them to believe that there will be an increased demand for pig in the course of a month or six weeks. In North Lincolnshire, too, a similar state of things prevails, two, at least, of the furnaces there having been relighted, in addition to the fourteen or fifteen which were in blast when the year came in.

Pig iron quotations are steady all round, at the figures quoted in these notes last week, the foundry brands being especially well upheld, owing to the renewed activity of several of these establishments. There is not only a more cheerful inquiry for pipes and colliery castings, but a much more considerable call for all sorts of machine castings and stove-grate work. A firm producing the last-named goods has just secured an order for 4000 sets, and other houses are nearly as well off.

At the brass-works there is no especially noteworthy change, all the chief makers of water and gas fittings having a fair supply of orders on hand and in course of execution.

The coal market still runs in a very quiet groove, there being a good deal of difficulty in obtaining the current prices of the day. The Sheffield Coal Company, Limited, have just issued a new list, which runs as under:—Picked brands, 13s. 6d.; best Birley Silkstone, 10s.; ditto picked cubes for the London market, 10s. 6d.; screened Silkstone nuts, 6s. 6d.; screened seconds, 6s. 6d.; coke breeze, 10s.; hard melting coke (washed) and slack (unscreened), 3s. per ton of 21 cwts., at the pit mouth near Sheffield.

THE LANCASHIRE COAL AND IRON TRADES.

(FROM OUR OWN CORRESPONDENT.)

Business, which is only just being resumed after the New Year's holidays, continues very quiet both in the coal and iron trades of this district, and so far as the general position of the market is concerned, there is but little change to notice, either as regards prices or demand.

Although stocks are not going down in the better classes of round coal, there is no push for supplies, the mildness of the weather still keeping back the demand for house fire purposes. For gas-making coals one or two inquiries continue to turn up in the market, but there is no special feature to notice with regard to this branch of trade, the bulk of the coal now sent away being to cover contracts. Common coal hangs in the market, and the common classes of burgy and slack continue a complete drug. Pit prices generally remain the same as those ruling last month, but there is a tendency towards weakness in the inferior descriptions of fuel, and to effect sales of common burgy and slack very low rates are in some cases accepted. The average pit prices in the Wigan district remain about as under:—Best Arley, 11s. to 12s. per ton; Pemberton four-feet, 9s. to 9s. 6d.; common round coal, 7s. 6d. to 8s. 6d.; common steam coal, 7s. to 7s. 6d.; burgy, 5s. to 5s. 9d.; and ordinary slack, 3s. to 4s. per ton.

The shipping trade is not opening very favourably this month. During December a fair quantity of coal was shipped abroad; but at present there is not much prospect of any considerable foreign shipments for January, whilst the coasting trade is in a very stagnant condition.

In the iron trade buyers are generally holding back until after the quarterly meetings, and there is very little going on in the market. With the exception of a few holders of Cleveland iron, who appear anxious to put their stocks upon the market, prices are maintained, makers, as a rule, being firm at late quotations; the local smelters having sufficient orders on hand to keep the few furnaces at present in blast going for the next couple of months. Lancashire pig iron, delivered into the Manchester district, is still quoted at from 57s. to 58s. per ton for No. 3 foundry, and 55s. to 56s. per ton for No. 4 forge. The finished iron trade continues steady, local forge proprietors, as a rule, being tolerably well supplied with orders, and for Lancashire bars, delivered into the Manchester district, £6 17s. 6d. to £7 per ton is asked.

THE COAL AND GENERAL TRADE OF THE NORTH.

(FROM OUR OWN CORRESPONDENT.)

Last week, as the week before, the coal trade of the Tyne and Wear partook very much of a holiday character, and very little business was done. Most of the larger contracts for gas coals have been arranged for next year. Last week, notwithstanding the stoppage of steamers was greater than ever by tempestuous weather, the shipments of gas coals by them from the Tyne Dock were a good average. Most of the steamers which had been detained in the Tyne from Monday got to sea on Friday, and by the time this column is printed, it is every way possible there will be another large delivery of sea-borne coal in London river. It is astonishing how the steamers have overcome difficulties in connexion with the navigation between the Tyne and London during the past three weeks. And it says much for the perseverance and determination of the men who navigate them, that they have carried such a vast deal of property through some of the worst weather we have experienced for years with so small a loss. Second-class gas coals remain pretty much where they have been for the past three months, and that is not a very strong position. Household coals are about 6d. per ton lower, with a very poor demand. Steam coals are not much inquired after, and the pits, as a rule, are working short time.

There is an abundance of tonnage in the coal ports, and very few coasting orders. Small sailing vessels are in little demand. Steamers are paid from 4s. 6d. to 5s. per ton to take coals to London, Hâvre 6s. per ton, Hamburg £7 10s. per keel. The demand for gas coal for the Mediterranean is well sustained, and higher rates are paid for steamers to load thence.

The iron trade of the North of England is about, off and on, what it has been for a fortnight. If anything, it is creeping up a little. In anticipation of a war in the East in spring, a large speculative business is being done by shipowners in new iron steamers. The shipbuilding yards of the Tyne, the Wear, the Tees, and Hartlepool have suddenly emerged from a condition of extreme depression to considerable activity. Most of the steamers built are of large tonnage.

At present manufacturers are busy stock-taking, and making up their books for the past year. Under these circumstances, therefore, very little new trade will be entered upon until the end of January. But there is no doubt the position of affairs in the East continues as a very disturbing influence on trade. It has introduced a large element of uncertainty into it, and if the armistice continues until March, with no definite idea as to the result at its termination, business will go on after a hand-to-mouth fashion well into the spring.

TRADE NOTES FROM SCOTLAND.

(FROM OUR OWN CORRESPONDENT.)

The directors of the Blairgowrie Gas Company have intimated a reduction in the price of gas, from 7s. 6d. to 6s. 8d. per 1000 cubic feet.

At the usual monthly meeting of the Town Council of Aberdeen, held last Thursday, the Gas Committee reported that they had received various tenders for supplying four dry lime purifiers and additions to the scrubbers at the Corporation Gas-Works, as sanctioned at the December meeting of the council, and that they had accepted the following, which were the lowest, namely—For the purifiers, Messrs. James Garvie, jun., and Co., £869; for the scrubbers, Messrs. Blaikie Brothers, £199 10s. Bailie Donald, the convener of the Gas Committee, in supporting the approval of the minutes, gave notice of a motion that it be remitted to the Gas Committee to look at the salary paid to the present manager, Mr. Smith, with a view to making some advance. The matter was eventually remitted to the committee for consideration and report.

A very remarkable, and at the same time interesting, illustration of the recent rapid growth of business in Paisley was furnished at a late meeting of the Corporation Gas Committee, at which plans for increasing the production and storeage capacity of the works were discussed. The consumption of gas 30 years ago, when the bargain between the gas company and the corporation was arranged, was 48 million cubic feet per annum. In 1866—20 years afterwards—it was 62 million cubic feet per annum; while last year—after the lapse of another decade—it was no less than 134 million cubic feet. No more conclusive proof of the growing prosperity of the town could be adduced.

Several matters connected with the corporation gas supply came up for consideration at the monthly meeting of the Town Council of Glasgow, held last Thursday. With reference to the carrying out of gas contracts, it was resolved—"That nothing contained in the Standing Orders enacted by the magistrates and council on Feb. 23, 1857, shall prevent the committee on gas supply from purchasing articles which they consider necessary for the proper carrying on of the gas undertaking, or from entering into contracts for coal, or other commodities required for that purpose, without having previously obtained the sanction of the Town Council." Mr. John Taylor, jun., who proposed the resolution, remarked that the Standing Orders had served the Town Council tolerably well, but since they became gas managers the ninth one, which restricted the expenditure to £50 daily, was infringed every day, for he might state that the operations of the Gas Committee involved a revenue of £364,000 per annum, so that to limit the power of spending to £50 a day was quite ridiculous. In connexion with the Gas Committee's minutes, Mr. Finlay remarked that it was some time since the council remitted to the committee of the Improvement Trust, and the committee of the Gas Trust to do something with the old gas-works at Townhead, which had now remained idle for three years. The committees had not been able to come to any determination as to what was to be done with the property. He thought the council should issue some instructions, which the Gas Trust might feel it in their power to obey. A long discussion ensued, in the course of which it was strongly urged that the Improvement Trust should secure the property, the value of which was set down at £25,000. It is thought probable that the Gas Committee will be able to secure that amount for it. The Gas Committee's minutes showed that the question of discontinuing the Partick Gas-Works had been under consideration, and that the sub-committee on works had agreed to delay making any recommendation in regard thereto in the meantime. The salary of Mr. Davidson, manager of the Dawsholm Station, has been increased to £300 per annum, as from the 11th of July last; and on the recommendation of Mr. Foulis, the general manager, it was agreed last month to get 50 of Giroud's rheometers to be tested in the street-lamps in lieu of the regulators which are at present in use.

On Friday week, the ninth annual festival of the *employés* of the Gas Commission took place, on which occasion Mr. M'Crae, the manager, delivered an interesting address as chairman of the meeting. He said that there were in all 230 people connected with the works, and that the firemen had only to work 56 hours per week. Every 24 hours they used 140 tons of coal, producing 1,600,000 cubic feet, or 27 tons of gas, the balance being tar, naphtha, ammonia, coke, ashes, &c. The gas was sent through upwards of 120 miles of pipes, and what was at the moment being made by the workmen would be consumed in the place of meeting in about fifteen minutes. They had 29,000 meters at work, measuring the 27 tons of gas, a process which went on every moment of the night. In a few minutes more than an hour nearly 4000 public lamps were lighted, and they were extinguished in about the same length of time. Above 300,000 visits were paid every year to the consumers by the officials of the Gas Commissioners, which was about 1000 visits per day. Mr. M'Crae also referred to the complaints made to the officials and to the commissioners. At a meeting of the Gas Commissioners last Wednesday, a letter was read complaining of the quality of the gas. It was stated that the gas was not only bad, but the consumption had increased enormously. Mr. M'Crae, the manager, stated that in an immense number of cases the fittings in the houses were inadequate, and no system of regulation would be sufficient to give good gas or prevent an extreme consumption. The only way to prevent complaint was to make a radical change in the character of the fittings. The matter was left over for further consideration. With reference to this matter, the leading local newspaper (the editor of which is "well up" in gas affairs) suggests that the Gas Commissioners should reduce the illuminating power of the gas at a given date, so as to see whether or not 14-candle gas affords more light than that of 28-candle illuminating power. The writer shows, by reference to his own accounts, for nine months in 1875 and in 1876, that, by dint of proper management of the burners and the pressure, his consumption of gas has diminished, even though the number of burners has been increased.

At a meeting of the Dundee Water Commissioners, held last Thursday, Provost Robertson laid upon the table the revised account of Mr. Easton Gibb, the contractor for the Clatto Reservoir. It appeared that the contract price was £23,000; but, in addition, a bridge had to be erected, at a cost of £174. The total extras which had to be paid amounted to £970. For the Lintrathen and Clatto Reservoirs Mr. Gibb had done work to the amount of £59,000, and the extras on the whole of that scarcely came to 5 per cent. The commissioners expressed themselves highly satisfied with the excellent character of the work, and that the contract prices had been so little exceeded.

On Friday last the ceremony of cutting the first sod in connexion with the long-contemplated water-works for Galashiels took place. The total cost of the works, parliamentary expenses, &c., is set down at about £40,000, and there is to be a supply of 30 gallons per head for a population of 25,000. It is expected that the works will be finished in the course of another year.

The Inverness Police Commissioners have just resolved on applying to the Public Works Loan Commissioners for the loan of a sum of £6000, the balance of £41,000, which had been voted for completing the new water-works.

In the early part of last week the price of pig iron in the Glasgow market declined somewhat. By the end of the week, however, prices

recovered to the extent of 4d. per ton, and 1d. per ton over the closing price on the 22th ultimo. The closing price was 57s. 10d. cash.

Orders for coal are very scarce, both for shipping and for local trade, but a hope is entertained that the demand will soon increase. For the present quotations are a shade weaker.

Reduction in the Price of Gas.—The price of gas at Frome has been reduced, from the 1st inst., to 3s. 9d. per 1000 feet, with discounts to large consumers.

Richmond (Surrey) New Water Supply.—The *Surrey Comet* of Saturday states that some of the residents are already receiving the water provided by the vestry, and satisfaction has been expressed at the excellent supply. Others will be supplied as soon as the necessary connexions can be made.

Explosion of Gas at Kingsland.—At about a quarter to seven on Thursday evening last, an escape of gas caused an explosion, which set fire to the residence of Mr. H. Osborn, bonnet-shape maker, 69, Kingsland Road. The skylights of the workroom in which the explosion occurred were blown out, but the fire was extinguished, owing to the prompt arrival of the engines, before any very serious harm had been done.

Aberdare Local Board Pipe-Laying.—Some time since a contract was taken by Messrs. S. Chandler and Sons, of Newington Causeway, London, for about 15,000 yards of pipe-laying, which was to be completed in three months. This was done, and not only so, but done efficiently, and since the time of maintenance has expired, the cost for repairs to roads and joints, during the six months has only amounted to £1 14s. 5d.

Quality of the Newcastle-on-Tyne Gas.—Mr. John Pattinson reports the following as the results of his examination for the past week of the quality of the gas supplied to this borough by the Newcastle-upon-Tyne and Gateshead Gas Company:—

Date—1877.	Illuminating Power in Sperm Candles.	Grains of Sulphur in 100 Cubic Feet of Gas.	Sulphuretted Hydrogen.
Jan. 2	14·1	6·56	Nil.
„ 5	14·2	6·91	Nil.

According to Act of Parliament the gas should not be of less than 14 standard candles illuminating power, nor contain more than 17 grains of sulphur per 100 cubic feet of gas.

Explosion of Gas at Arundel.—An alarming explosion of gas occurred here a few days ago. A girl in the service of Mr. W. Atfield, of Causeway Villas, Arundel, was in the act of entering the front sitting-room with a lighted candle, at a quarter to seven, when a fearful explosion occurred. Two railway porters, who happened to be passing, rushed into the house, and found several articles on fire, and the girl screaming loudly. They immediately put out the fire, and removed her to a cottage close by, where she was attended by Dr. Hubbert and Mr. C. L. Evershed. It was found that she was suffering from severe burns and general shock to the system, and she is at present in a very precarious condition. The kitchen, drawing-room, sitting-room, and dairy were completely wrecked, the furniture being blown about, and burned, in all directions. The report was heard at a distance of quite two miles. The total damage done is estimated at £300.

Gas Explosion at St. Helen's.—On Thursday evening, an explosion of gas occurred in the house of Mr. Joseph Beasley, St. Peter Street, St. Helen's. During the evening the inmates of the house smelt a strong escape of gas, and about seven o'clock a son of Mr. Beasley, about 15 years of age, went into the parlour to ascertain the cause, taking with him a lighted candle. He had no sooner entered the room than a violent explosion took place, the lad being thrown down with great force, and severely burned about the face and hands, his clothes being also literally singed off him. The window was blown out, as was also that of a bed-room above, the gas at the same time making its way into the lobby with such force as to blow the street door out, throwing it to the other side of the street, and smashing it into splinters.

Proposed Purchase of the Droitwich Gas-Works.—At the meeting of the Droitwich Town Council on the 1st inst., a report was read from the Watch and Lighting Committee, stating that they had received a deputation from the gas company, and again discussed with them the terms offered by the company for the sale to the corporation of the gas-works, and that they had, subject to the approbation of the council, agreed to purchase the same at the sum of £3675, such amount to include all stock, materials, and property of every kind belonging to the company, except the gas, coal, unused lime, and new gas-fittings, which it was agreed should be taken to at invoice cost price; the purchase, if no financial difficulty intervened, to be completed at Midsummer next. After considerable discussion the report was unanimously adopted, and steps were ordered to be taken to carry out the sale and purchase.

Water Supply of Mexborough.—The local board having, in accordance with their former resolution, advertised for tenders for carrying out the water supply of the town by a private company, it was stated, at their meeting, on the 4th inst., that ten engineers had sent in applications. Mr. Brundell, C.E., attended the board, and explained the particulars of a scheme which he prepared in 1874, based upon a supply of water near Manvers main, known as "Shrogg's scheme," at an estimated cost of £10,858. He proposed to give a supply for double the present population, and all the material to be of the very best and most durable kind. There would be a pumping-station and well, also an engine of 24-horse power, capable of supplying 200,000 gallons in 12 hours. He had also estimated for an engine-house and boiler-house; also an additional engine and boiler house for contingencies. There were also two service reservoirs (covered), one to hold a two and a half and the other a two days supply. Mr. Tomlinson, C.E., also appeared before the board, and offered to form a company to carry out the water scheme for £6000; to find the necessary capital; and to enter into a legal agreement with the board for the purchase, at any time (by the board) of all the various works, at a premium of 10 per cent. on the outlay.

Treatment of Sewage at Salford.—At a meeting of the Salford Town Council on Wednesday last, a report was submitted by a committee to the effect, that they had visited the sewage-works at Leeds, Bradford, Birmingham, Coventry, and Edmonton, for the purpose of obtaining the fullest information on the subject of the treatment of town sewage. The report having given an account of the various systems adopted at the different towns visited, concludes as follows:—"The committee have given the above processes their most careful consideration. They are of opinion, and beg to recommend to the council, that the contemplated works for the borough of Salford should be constructed on the principal of precipitation, and that the borough engineer should be instructed to prepare the necessary plans and drawings as soon as possible accordingly. Inasmuch as any chemical process for the precipitation of sewage can be applied to works constructed on this principle, the committee do not at present make any recommendation to the council as to the selection of any particular mode of treatment. They consider it advisable to wait until the intended works are approaching completion, in order that they may have the latest scientific information to guide them in the selection of a process for the approval of the council." On the motion of the chairman of the committee, it was resolved that the recommendation contained in the report be adopted, and that the borough engineer be instructed, under the direction of the Building Committee, to prepare plans for the treatment of the sewage of the borough on the principle of precipitation.

Hull Water-Works.—At the meeting of the Water-Works Committee of the borough of Hull, on the 1st inst., the engineer (Mr. Maxwell) reported that the total water pumped at Stoneferry during the previous fortnight was 71,106,427 gallons; average daily supply, 5,079,030 gallons. Coal consumed, 96 tons 6 cwt.; ditto per million gallons, 27 cwt.; cost of ditto, 14s. 8d. The Springhead wells were just beginning to receive the influx of the autumn rains. The rainfall this season had been so abundant that there was no fear of scarcity in the springs during the ensuing summer. The contractor had completed the second new bore, having pierced through the chalk into impermeable blue clay, at a depth of 404 feet. He was now making the connexion between the bore and adit. The engine contractor had drawn out and replaced the second set of lift-pump valves, and the engine was again at work. Mr. Maxwell recommended that the new engine-house should be boarded round to a height of 7 feet 6 inches above the floor, and the upper portion of the walls painted instead of plastered. He also presented the following summary of the quantity of water supplied to the town, and the cost of coal and labour for the last five years:—Water supplied: Average of years 1872-3-4, 1660 million gallons; in 1875, 1659 million gallons; in 1876, 1815 million gallons. Coals consumed at Stoneferry: Average of 1872-3-4, 3005 tons, costing £3274, or 39s. 2d. per million gallons; ditto, in 1875, 2167 tons, costing £1760, or 21s. 3d. per million gallons; ditto in 1876, 2356 tons, costing £1426, or 15s. 9d. per million gallons. Coals consumed at Springhead: Average of 1872-3-4, 2479 tons, costing £2819, or 34s. per million gallons; ditto in 1875, 2749 tons, costing £2197, or 26s. 6d. per million gallons; ditto in 1876, 2855 tons, costing £1732, or 19s. 1d. per million gallons. Wages at Stoneferry and Springhead, and of turncocks and pipe-layers, as per weekly pay-sheets: Average of 1872-3-4, £4272 0s. 5d., or £2 11s. 5½d. per million gallons; ditto in 1875, £3483 13s. 6d., or £2 2s. per million gallons; ditto in 1876, £3208 10d., or £1 15s. 3d. per million gallons. The total cost of coal and labour per million gallons supplied: Average of 1872-3-4, £6 4s. 7½d.; ditto in 1875, £4 9s. 9d.; ditto in 1876, £3 10s. 1d. The engineer's report was adopted, and it was ordered that tenders should be advertised for the work required to be done in the new engine-house.

Petroleum Trade in 1876.—The fluctuations during the past year have been unusually rapid and severe, prices ranging from 9¾d. to 2s. 5½d. per gallon, and the excitement occasionally witnessed in our market has been hitherto unknown. Our principal supply has, as usual, been drawn from the United States, but during the year about 17,000 barrels have been imported from Canada, which met with a ready sale as a second-class oil, in the place of coal oil, which has been practically unavailable during the last few months. Some of this oil was of very fine quality, and could with difficulty be distinguished from Pennsylvanian. Should prices keep near their present level, we are led to believe that a continued supply may be looked for. The total shipments from America, including about 40,000 barrels of Canadian oil, to all parts of the world, were 236,751,446 gallons, against 221,710,049 in 1875, and 222,869,010 in 1874. This is the largest quantity ever shipped from the States in one year, and the increase is accounted for by large shipments to Japan and other Eastern markets. During the year the stock of crude oil in America has been very much reduced, and stands now at about 3 million barrels. On the other hand, although the number of wells is larger, the total daily production has not greatly increased. It stands now at about 26,000 barrels per day, against 25,000 barrels in 1875. Petroleum spirit continues to make its way with the public, and is in some districts a formidable competitor to petroleum oil. The total deliveries for the year are 61,875 barrels, against 57,569 barrels in 1875. Prices have fluctuated considerably, from 7½d. in May, to 1s. 5d., which is the present price. As far as London is concerned, the demand for common spirit appears to be steadily decreasing, its place being almost entirely taken by English rectified, which is now produced at a trifling cost above the price of common spirit. As to coal oil, the past season has been highly gratifying to the British refiners, but unfortunately for them not many of their works were remaining, and, consequently, they were unable to profit to the extent they could have wished by the late high prices. Our supply of this article has been drawn almost exclusively from Scotland, but although their works were fully occupied their total production was unable to keep pace with our demand, after satisfying their own local trade. This is to be regretted, as some of the oil was of very fine quality, and found a ready sale here at good prices.—*Messrs. Mordaunt Bros. Annual Circular.*

Liverpool Water Supply.—On the 18th ult. a special meeting of the Corporation Water Committee was held, to hear a statement from Mr. Mather, of the firm of Messrs. Mather and Platt, engineers, Manchester, with reference to the probability of obtaining a water supply from local sources. Mr. Mather said it was stated upon authority of the most reliable kind, that the triassic rocks below and around Liverpool had a depth of at least 1400 feet, and beneath these the permian might be found, overlying the coal measures, perhaps of a thickness of 200 feet. But they might assume, anyhow, that for 1000 feet or 1200 feet there was a clear section of water-bearing rock, consisting of sandstones of various degrees of porosity, separated from each other by thin partings of impervious marl or clay. This vast deposit extended, as Professor Dawkins and other geologists had shown, over an enormous area, with several great depressions tending to separate into basins, but yet having continuity throughout, bounded inland by the older rocks and the coal measures, and having freedom of outlet by gravitation seawards for the water it contained in the districts of Fleetwood, Southport, and Ormskirk. In this area it was obvious there was a vast supply of water at present untouched, which was kept up by the rainfall. It might be assumed that about 800 square miles of surface would contribute to this reservoir by percolation, if it were not to some extent covered by marls and clay. But at least one-third was exposed to the rainfall by being covered with sand, shingle, and drift at the outcrop. Moreover, the rivers flowing over the triassic rocks would contribute largely to this store, where not filled and overflowing with water. Now, if one-third of the rainfall be taken as the possible replenishment of these rocks, should they be drawn upon, they had a quantity of no less than 114,688 million gallons annually, apart from the incalculable store now locked up in this porous strata. In the presence of these figures there was little fear of exhaustion. At present these rocks were saturated, and the surplus water flowed over the surface. It was to this enormous store of water he would direct the attention of the committee. In order to liberate it, he recommended a boring of 1000 feet deep, of large diameter. After passing through some of the impermeable bands of marl or clay, or close sandstone, many of which existed in this formation, he would by mechanical means cut off all connexion between the rocks they had already pierced and those lying below, and the water of the sub-lying sandstone should rise to its normal level in the pipes lining the bore. The pump-barrel should be placed at such a depth as would keep it replenished with the quantity equivalent to

its extracting power, and thus a continual flow of pure water might be secured, untouched by drainage or sea-water, and entirely independent of that which they now used. His belief was that there was a vast source of water in these rocks, which would fill up as quickly as it was drawn upon, and that a quantity, equal to what Liverpool had at present, could be obtained by penetrating those lower rocks, and by putting down a series of bore-holes and pumping arrangements, such as he had described. Questioned by Mr. Forrest as to the time it would take to bore 1000 feet, and complete all the machinery, Mr. Mather said that, if a good price were paid, his firm could complete the work in twelve months, putting down a pump which could lift 8 or 10 million gallons per day. Asked further with regard to the cost, Mr. Mather said that the whole cost for buildings, engines, boilers, erections, travelling-cranes, and everything would be about £13,500. The working expenses would be about the same as that of the present wells.

"Chemical Analysis considered in its Application to Civil and Mechanical Engineering."—At the meeting, on Thursday last, of the members of the Civil and Mechanical Engineers Society, a paper, with the above title, was read by Mr. Bernard Dyer, F.C.S. The writer began by offering some remarks on the close connexion of chemistry with other sciences, drawing attention to the marked and subtle relations between the chemical composition and physical properties of various kinds of matter. The influence of minute proportions of certain foreign substances, such as phosphorus and sulphur, upon the quality of iron and steel, was alluded to under this head, as also were the variations in the electric conductivity of copper wire designed for telegraphic purposes, when certain impurities chanced to be present even in minute traces. The composition and properties of some of the principal alloys of copper, having been briefly referred to, the value of chemical science in studying the nature of furnace action, with a view to the economy both of heat and fuel, was considered, the advantages of systematic chemical analysis of the coal or coke used in most metallurgical operations being also pointed out. The subject of furnaces led to some observations on the nature of fire-clay and other refractory materials, the author showing that while, for all practical purposes, chemical analysis could decide upon the suitability or otherwise of a given clay for use in a high temperature, there was still room for sound chemical research in discovering the best artificial substitutes for natural fire-clay. The subject of water analysis was treated at some length, both as regarded the supply of drinking water and the suitability of various waters for boiler use, some practical remarks being introduced on the occurrence and prevention of boiler incrustations. The distinctions between "hard" and "soft" waters, and the softening of the former under treatment by Clark's process, were described, the author quoting a recent statement by a well-known engineer, to the effect that no less a sum than £50,000 is annually lost to the people of England by the wasteful consumption of soap entailed by the use of hard waters. The London water supply, if treated by Clark's process, would probably deposit upwards of 50 tons of chalk daily. The subject of oils and other lubricants, with reference to their adulteration with drying oils, and the consequent damage to machinery, having been alluded to, the paper was brought to a close with a passing reference to sewage purification, agricultural chemistry as affected by engineering, and gas—matters into which the author regretted that the limits of space and time at his command forbade him to enter further.

Register of New Patents.

264.—Johnson, S. H., Stratford, Essex, "*Improvements in the preparation of ferrocyanides from spent oxide of iron.*" Provisional protection only obtained. Dated Jan. 22, 1876.

In the treatment of spent oxide of iron with alkaline earths, which dissolves out the ferrocyanogen as a soluble salt of the base employed, it is usual (the inventor states) to acidify the resulting solution with hydrochloric acid, and then precipitate the Prussian blue by any of the well-known methods, but the product produced in this way is largely contaminated with free sulphur produced by the decomposition of the sulphide of the alkaline earth, formed by the action of the alkaline earth on the free sulphur existing in the spent oxide. In order to avoid this, he proceeds as follows:—The solution resulting from the treatment with the alkaline earth (lime, for example) is submitted to the action of a current of carbonic acid gas, which may be produced and passed through the solution by any of the methods usually employed, but he prefers to burn coke with air in a closed vessel, pumping the air into such vessel, so as that a pipe from the vessel may conduct the products of combustion into the alkaline liquid, or the air-pump may be connected with a flue from any adjoining furnace, and the flue gases after having been passed through the water will answer the purpose, provided that the fuel employed is of a comparatively smokeless character. This treatment decomposes the sulphide of calcium, forming carbonate of lime, which precipitates along with the sulphur. When the point of neutralization has been carefully attained, the liquid is allowed to remain at rest for some time, and then the clear solution of ferrocyanide of calcium free from the sulphide is drawn off into the precipitating vat for the precipitation of the blue in the usual manner.

273.—Johnson, J. H., Lincoln's Inn Fields, London, "*Improvements in apparatus for cleansing water from impurities.*" A communication. Patent dated Jan. 24, 1876.

This invention relates to improvements on the apparatus for cleansing water from impurities, described in patent No. 1552, April 29, 1873.

The improvements consist—1. In the addition and application of a tank or vessel constructed by preference of cast or wrought iron, and of a rectangular or circular form, which is placed above the upper tank or vessel, described in the former patent, in the centre or at the side of such tank, or in any other convenient position. 2. In dispensing with the tank placed in the upper tank, as described in the former patent, and in the application of a partition carrying the bearing for the axle or shaft of the bucket-wheel and the overflow-pipe in connexion therewith. 3. In the application of more simple arrangements for taking up the chemical ingredients or solutions, a rotating curved pipe, by preference having two arms or spouts, is employed, which pipe takes up the chemical solution out of a small vessel below. 4. In the employment of holes in the bottom of the lower tank and of outlet-pipes, which are provided each with a stop-cock or plug.

The apparatus operates in the following manner:—The water which is to be purified enters the additional tank through the supply-pipe at or near its bottom, where it becomes intimately mixed with the waste steam entering through the central pipe. The water is thus heated to a very high degree, and, consequently, deposits the carbonate of lime contained in it. The condensed waste steam separates or deposits all greasy substances, the particles of which, by the addition of chemical liquid in the lower tank, form a soap, which falls to the bottom, mixed with the heavy sulphate of barium. The heated water, with the uncondensed steam, passes through the additional overflow-pipe into the larger compartment of the upper tank, whence the water is conducted through the other channel or overflow-pipe, and falls into the buckets of the water-wheel, acting so as to turn the wheel. From the bottom of this compartment the water, after having worked the wheel, flows by another pipe into the lower tank near one end, and it then passes along this tank in a zig-zag direction, alternately downwards and upwards, on its way to the opposite end, where it is discharged at the upper part. The steam arriving in the upper tank passes through a pipe, which reaches above the level of the water to the end compartment of the tank, and escapes through another pipe into the atmosphere.

281—Brinjes, J. F., Whitechapel, London, "*Improvements in apparatus for raising, forcing, and exhausting water or other liquids, also air and gases.*" Patent dated Jan. 25, 1876.

This invention consists in the combined use of a cylinder, acting as a piston or plunger, working eccentrically within an outer fixed cylindrical casing of any desired length and diameter, and between two end covers, and having a gyratory in lieu of a rolling motion therein, as heretofore, with a radial web or partition rigidly secured longitudinally to the outside of the gyratory cylinder or piston, or cast thereon, and working fluid-tight within a radially disposed chamber, which is formed on and extends the entire length of the outer cylindrical casing, the inlet and outlet orifices being separated by the radial web or partition.

The gyratory motion is imparted to the inner cylinder or piston by one or more cranks or eccentrics working in the interior of the gyratory piston, and formed or carried on a revolving shaft concentrically disposed within the outer fixed cylinder, and working in bearings in the end covers, and as the radial web or partition is rigidly secured to the inner cylinder or piston, and is also controlled by the chamber on the outer cylindrical casing, within which it works to and fro, it is obvious that although the inner cylinder or piston will be caused to follow a circular course round the inside of the outer cylindrical casing, it cannot rotate on its own axis or roll over the interior of the outer casing, the nature of the motion of the cylinder or piston and its radial web being in fact precisely analogous to that of an ordinary eccentric strap and rod.

The amount of motion of the gyratory cylinder or piston will, of course, depend on the length or amount of eccentricity of the actuating cranks or eccentrics, and the difference between the diameters of the inner cylinder or piston and the outer fixed casing.

392.—Weyhe, W., Bremen, "*Improvements in apparatus for raising or forcing fluids.*" Patent dated Feb. 1, 1876.

This invention relates to an apparatus for raising or forcing fluids, wherein a piston receiving both longitudinal and rotary motion in a closed cylinder is so arranged that while it draws fluid into and expels it out of the cylinder, it at the same time effects the alternate opening and closing of the inlet and outlet ports without the use of valves. For this purpose the piston has formed round its periphery an oblique groove, into which fits a roller projecting from a recess in the side of the cylinder. The piston-rod is provided outside the cylinder with a crank or pulley, by which rotary motion is imparted thereto, and as the piston is made to revolve the effect of the roller fitting in the oblique groove will be to cause the piston to move backwards and forwards in the cylinder, so as alternately to draw fluid into and expel it from the cylinder on each side of the piston. The cylinder is provided at some distance from each end with two opposite ports, one for inlet and one for outlet of fluid, and the piston has formed upon it on each side a projection or shield fitting against the side of the cylinder, and extending so much beyond the semicircle that in a certain position it just covers both the inlet port and the outlet port, the two shields being in opposite positions on each side of the piston, and so arranged that they each close their respective ports in one and the same position of the piston—namely, when this is at either end stroke.

Assuming, now, that the piston is at the end of one of its strokes, it will by its continued rotation be made to commence its return stroke, while at the same time its one shield, in revolving with it, will begin to uncover the inlet port on the one side, and the other shield will begin to uncover the outlet port on the other side, and the ports will continue open until the piston has performed half a revolution, and at the same time arrived at the end of its stroke, by which time the shields will have again closed the ports, and will now commence to open the other inlet and outlet ports as the piston begins its next stroke.

When the apparatus is constructed of large dimensions it is preferred to assist the action of the roller and oblique groove in imparting the requisite longitudinal motion to the piston by connecting the piston to the one end of the cylinder by means of a link situated to one side of the axis of the cylinder, so that when the piston is turned from the position in which the link is parallel to the axis into that in which the link must assume an oblique position, the effect will be that the link will draw the piston towards its end of the cylinder, while as by the continued rotation of the piston the link moves from the oblique into the parallel position again, it will push the piston towards the other end of the cylinder.

497.—Mason, C., Southampton Buildings, London, "*Improvements in and relating to valve apparatus for steam-pumps and other purposes.*" Patent dated Feb. 8, 1876.

In these improvements an ordinary D valve, having a bracket or prolongation on its back, works against the three-ported valve face of the cylinder. This valve face has the ports near together, as usual, but has a much longer blank surface beyond the outer side of each steam port than is generally the case. The bracket cast on the back of the valve is securely held by a valve spindle, having a piston at each end working steam-tightly by means of piston rings or other packing in cylindrical or other casings. These casings are freely open to the steam-chest on the inner side nearest the valve, but have no openings into them beyond the piston, except the steam passage. They are firmly fixed to the valve face of the cylinder, the casting joining them usually forming the steam-chest. In the large blank surfaces of the steam-chest, on each side of the ports, two smaller ports are constructed, quite clear of the travel of the main valve. Of these ports, the one nearest the main valve ports is connected with the exhaust, the other with the steam passages opening respectively in the casings behind the pistons. Two small auxiliary valves work against the valve face opposite these two pairs of ports, and are connected together and grasped by the same valve-bracket or spindle. This bracket usually encircles the main valve, passing round each side of it without touching it, and is attached at each end to spindles working in stuffing-boxes in the ordinary manner. Or instead of passing round the main valve, the spindle can pass through a hole or tunnel in the valve made in it for the purpose.

Supposing the valve to be working vertically, the following is the mode of action:—The auxiliary valve-spindle being slowly lowered exposes the steam port of the upper auxiliary valve to the steam, which rushes through the steam passage to the upper side of the upper valve-piston, and depresses it; at the same time, by a precisely similar but opposite process, the steam below the lower valve-piston is admitted to the exhaust. The two pistons in descending move the valve, and thus let steam into the upper port of the engine cylinder, causing the piston to descend. This reverses the motion of the auxiliary spindle, which in its turn reverses the main valve, and thus causes the return stroke, and so on indefinitely.

499.—Köttgen, F. W., Barmen, Prussia, "*An improved pumping-engine.*" Patent dated Feb. 8, 1876.

This invention relates to an arrangement of pumping-engines by which certain important advantages are attained over the constructions at present in use.

The engine is arranged with two cylinders properly supported on beams and columns. Below the cylinders is placed a crank-shaft with a fly-wheel, the connexion between the piston-rods and the cranks, as well as the arrangement of the guides, being similar to the engines called inverted cylinder engines. The two cranks, however, are not placed at an angle of 90° to each other as usual, but in opposite directions—*i.e.*, at an angle of 180°, so as thereby to balance the two sets of pump-rods and other parts in reciprocating motion. The piston-rods pass through the tops of the cylinders, and the upper end of each of them is attached to the end of an oscillating beam in the usual style of beam-engines. The two beams, however, converge towards each other, so that their extreme ends, to which the pump-rods are attached, are brought close together over the shaft of the mine, or, in general, over the two sets of pumps.

508.—Newton, A. V., Chancery Lane, London, "*Improvements in centrifugal pumps.*" A communication. Patent dated Feb. 8, 1876.

This invention consists in various constructions and combinations of parts, whereby a more copious discharge is obtained for a given diameter of pump-case cylinder, power is economized in the operation of the pump, and the construction of the latter cheapened; also its capacity or ability to pass foreign bodies or substances is enlarged, likewise increased facilities are afforded for putting together and removing the working parts without disturbing either the suction or discharge connexions, and other advantages are obtained, including an increased facility for varying the working position of the pump.

675.—Kidd, J., Dartmouth Street, Westminster, "*Improvements in apparatus for the manufacture of gas for lighting and heating purposes.*" Provisional protection only obtained. Dated Feb. 18, 1876.

This invention is an improvement on patent No. 531, Feb. 13, 1875, and consists in combining with the gas-producer there described, a carburetting apparatus, together with ascending and descending pipes for cooling the gas, and also a small portable steam boiler for generating the necessary steam for the jet.

In carrying out the invention, a furnace is made, similar to the one described in the former patent, but in lieu of the coil, a small portable boiler is used for generating the steam required. This boiler should be heated by a gas or oil burner, so as to give off a regular flow of steam to the jet. The gas, after it leaves the furnace, passes up an ascending and down a descending pipe; the gas being cooler in the descending-pipe acts as a syphon, and increases the pressure. The gas then passes through a carburetting apparatus of any desired form or internal arrangement, after which it is ready to be used for lighting purposes. The gas, before it is carburetted, is non-luminous, and may be used for cooking or heating purposes. The carburetting material should be shale or petroleum spirit, such as is now used in air-gas machines.

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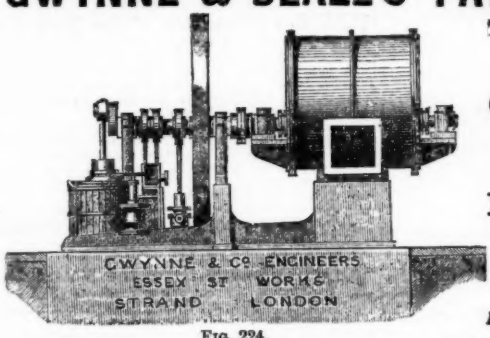

Fig. 224.

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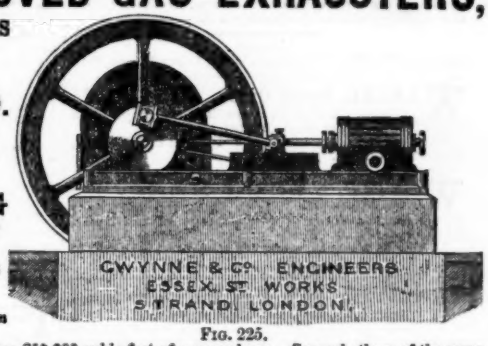

Fig. 225.

Fig. 224 represents one of those erected at the Imperial Gas-Works, Bromley, capable of passing 210,000 cubic feet of gas per hour. Several others of the same size are now on order for the same Company. These Patent Machines combine the highest quality of workmanship and materials, the largest bearings and wearing surfaces, with the **most perfect system of action yet discovered.** Fig. 225 represents one of a series of four at the Nottingham Gas-Works, each passing 52,500 cubic feet per hour. Gwynne and Co. *do not pretend to enter into a struggle with other makers in respect to cheapness. They have never sought to make price the chief consideration, but to produce Machinery of the very highest quality, and the most approved design and arrangement.* Their prices have been estimated with a due regard to the **excellence of the article produced,** and when this is taken into consideration, they have no fear for the result. The orders executed this season for Exhausters and alterations to their patented system amount to over 4,000,000 cubic feet of gas passed per hour, and to over 300 horse power for Engines to drive them. In every instance their work is giving the greatest satisfaction. Numerous testimonials and references can be given.

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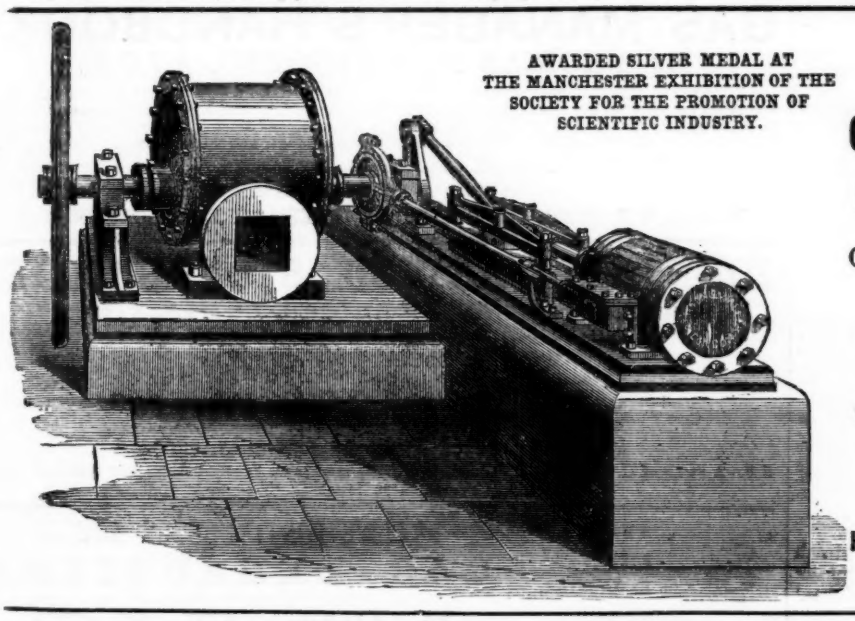

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By order of the Directors,
S. B. DARWIN, Secretary.

Gas-Works, Dec. 28, 1876.

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Gas-Works, Castleford, Jan. 1, 1877.

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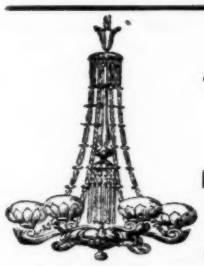

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By analysis, these Coals give 10,000 cubic feet of gas per ton, with an illuminating power equal to 14·5 sperm candles, and a large per centage of first-class Coke.

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The above forms are registered.
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MR. W. H. BENNETT, having had considerable experience in matters connected with Gas, Water, and Sanitary Improvement, begs to say that he continues to assist Inventors in the perfection of their designs, and to obtain for them PROVISIONAL PROTECTION, whereby their invention may be secured for Six Months; or LETTERS PATENT, which are granted for Fourteen Years.
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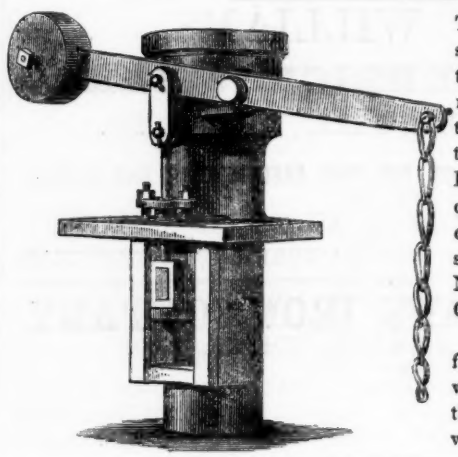

THE advantages of this Dip will be seen from the engraving. It is thoroughly effectual in its working, removing the whole of the pressure of the hydraulic main from the retort, thus causing a great saving in gas. It is very easy of manipulation, requiring little care and attention; it cannot get out of order, and, when shut, works as an ordinary Dip-Pipe. No accumulation of carbon in retort. Can be fixed to existing H-pipes.
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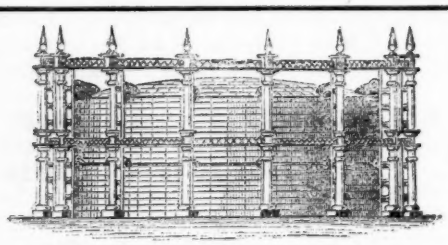
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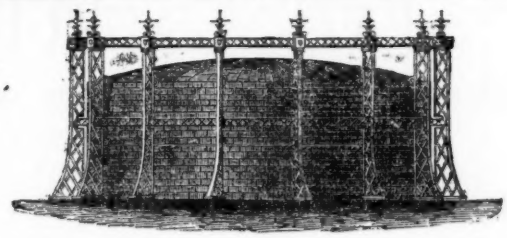

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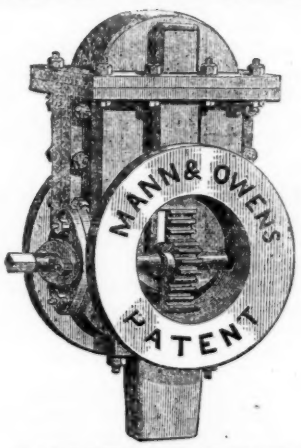
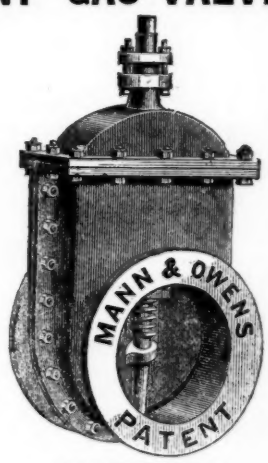


RACK AND PINION VALVE.



SCREW VALVE.

The advantages of this Patent Valve over all others yet introduced are, that it is always as tight as the best wedge or spring valve, without the possibility of setting fast or becoming suddenly leaky. The surfaces not being in contact during the operation of opening or closing, leakage through wear and tear is avoided.

The Gas Engineer will not fail to see the importance of such a valve in connexion with his purifying apparatus, particularly in the case of large sizes.

The slide being operated either by a screw and nut, or by a pinion and rack, a cam bearing upon a plane, cast on the back of the Valve, forces it against the face, and renders the escape of gas an impossibility. By a slight turn of the pinion or screw, the slide is released, and brought away from the face, by which means friction is avoided, and the only force required to open the Valve is that due to its own weight.

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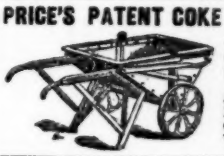

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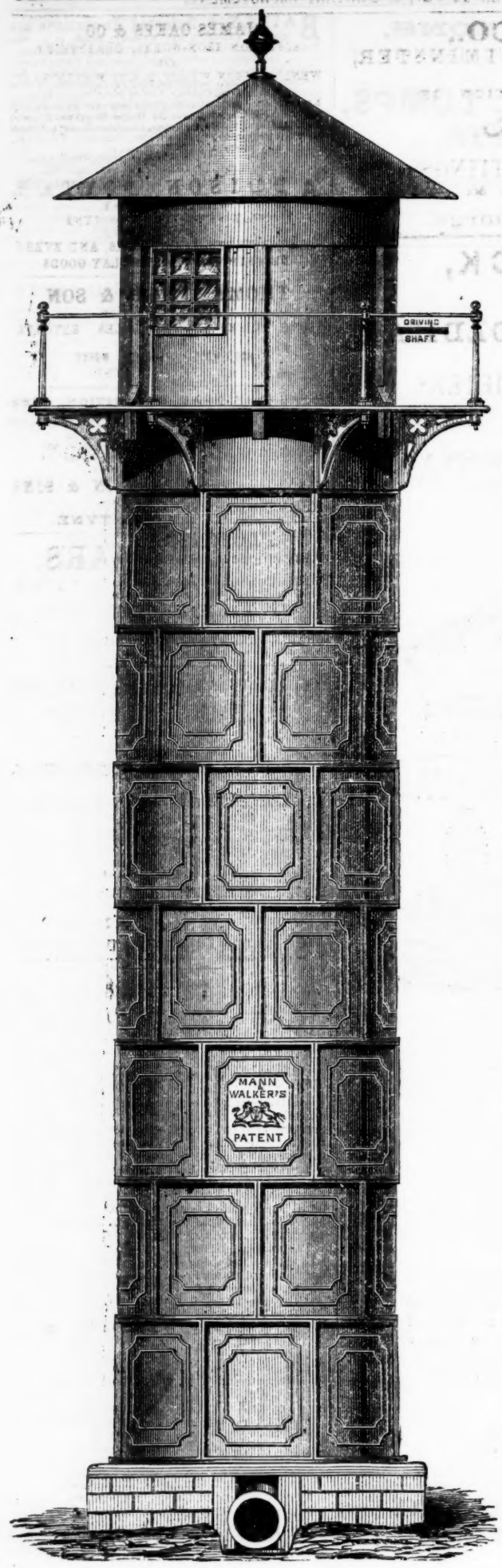

By Letters Patent in Great Britain, Europe, and the United States of America.

By some important improvements recently patented, the purifying power of these Scrubbers has been much increased, and a stronger ammoniacal solution obtained, which is found to absorb a large portion of the carbonic acid contained in gas, effecting an important saving in money and labour in the lime purifiers, and where oxide only is used, the increase in the illuminating power of the gas obtained by these Scrubbers is shown in a remarkable degree, in consequence of the large quantity of carbonic acid removed from the gas.

It is to be particularly noted that the im-portant results of these Scrubbers do not depend upon the machinery alone. The entire internal construction of the Scrubber bears an almost equally important part. For this reason, where it is desirable to convert existing Scrubbers, whose dimensions happen to be suitable, the work commences by ripping out the whole of the interior of the shell, and beginning the internal construction *de novo* from bottom to top.

They are, in all cases, constructed under guarantees to perfectly perform their work. They are now extensively used in the largest gas-works of London and the chief cities of Europe, the number in use exceeds **one hundred,** and their perfect efficiency and profit to a gas company have been fully established with every variety of coal used in Europe. References can be given to the largest gas-works in Europe.

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Foul Gas, properly condensed, entering the inlet is, by once only passing through the Scrubber, completely purified from ammonia with regular certainty day by day, without any further trouble, or any other process, effected by a very small quantity of clear water let into the machinery room at the top of the Scrubber, which is discharged at the liquor outlet at the bottom, from Newcastle coal at about 18 to 20 ounces strength, from Yorkshire and other coals, generally from 25 to 30 ounces strength; while acidulated litmus or turmeric exposed at the Scrubber outlet will not show the slightest discoloration, and there is not a quarter of a grain of ammonia per 100 feet left unabsorbed.

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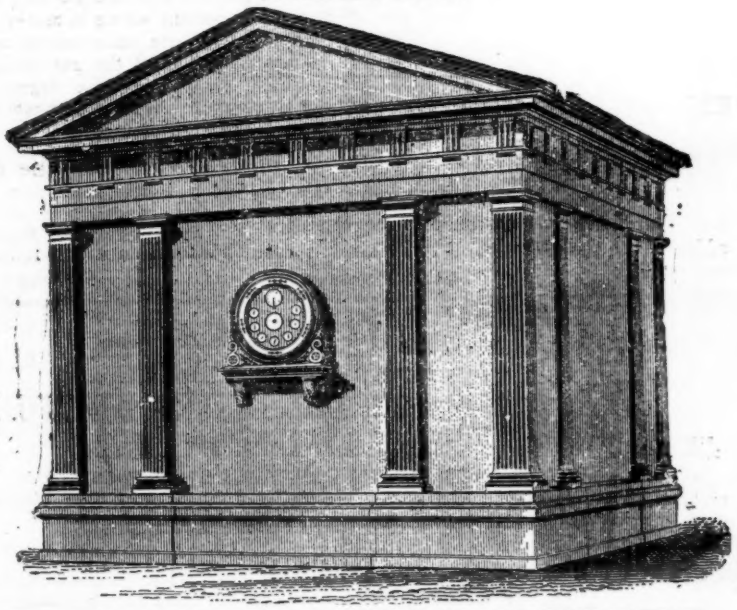

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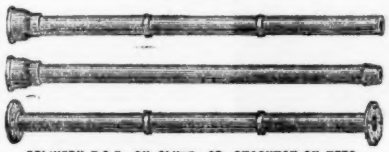

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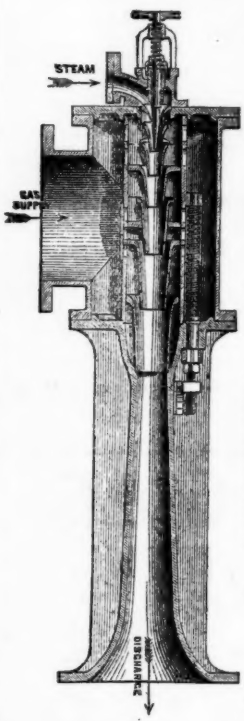

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STRONGLY RECOMMEND A TRIAL OF THEIR

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Analysis by F. J. EVANS, Esq., Chartered Gas Company, Horseferry Road, Westminster:—

(COPY.)

	Cubic Feet of Gas per Ton of Coal.	Illuminating Power in Candles.	Coke per Ton of Coal used.	Ash in Coke, per Cent.	Sulphur in Coal, per Cent.
Silkstone Nuts . . .	10·800	15·85	12·66 cwt.....	6·0	0·69

NOTE.—The illuminating power of the gas was tested by the standard burner now used in London by the Gas Referees, under the City of London Gas Act, 1868.

Horseferry Road, Westminster, March, 1870. (Signed) F. J. EVANS.

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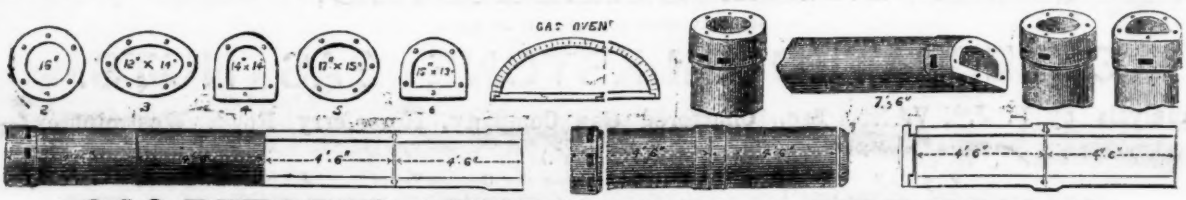

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